Canada Ontario

# TRACE ORGANICS IN ONTARIO DRINKING WATER ALONG THE NIAGARA RIVER

CANADA-ONTARIO REVIEW BOARD

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L'Accord Canada-Ontario relatif à la qualité de l'eau dans les Grands Lacs

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## DISCLAIMER

Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

## FOREWORD

This report on "Trace Organics in Ontario Drinking Water Along the Niagara River" has been prepared for the reader as a comparison to the report of the Niagara River Toxics Committee (NRTC). Its purpose is to interpret the findings of the NRTC, relating to the ambient conditions in the river, in terms of their significance for Niagara area drinking water supplies in Ontario.

There are no new data presented in this report. All information on the quality of raw and treated water at Niagara area water treatment plants (see Table 4.1) is based on water samples collected from mid 1981 to the end of 1982, and has previously been made public. This period was selected because it corresponds with the sampling period of the NRTC's programs. While this does not imply a direct correlation between the results in this report with those in the NRTC report (different ranges of parameters were analysed, and sampling took place at different times), a measure of compatibility exists.

This report takes the results of the Ministry of the Environment's sampling programs at Niagara area plants over the period mentioned. It then compares those results with the chemicals categorized by the NRTC as being known or suspected to be of most concern from a human health standpoint. By a process of elimination, the chemicals that have been identified in raw or treated water are separated into those that have guidelines and those that do not, and those that are of concern for human health and those that are not. Appropriate recommendations are then made to expand the range of chemicals being monitored, and to develop guidelines or human health assessments.

This report differs from the "Drinking Water Survey of Selected Municipalities in the Niagara Area and Lake Ontario", issued by the Ministry of the Environment in November 1984. In that survey, sampling was carried out at seven water treatment plants

(including four in the Niagara area). The results provided the most up to date and comprehensive information on the quality of treated water supplies from those plants. The range of chemicals analysed included all 139 chemicals identified by the NRTC as being present in the ambient water environment of the river.

The survey compared all of its results with relevant information on existing drinking water guidelines, but did not make any recommendations.

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## CONCLUSIONS

1) The Niagara River Toxics Committee (NRTC) identified, in its Group I list, 55 chemicals of concern that require immediate attention. In its Group IIA and IIB lists, the NRTC identified 45 additional chemicals that require continued or expanded assessment efforts. It should be stressed that not all of these chemicals are of concern from the standpoint of human health. Of these 100 chemicals in Groups I, IIA and IIB, 48 are organic chemicals that were identified as being of concern in water in terms of their implications for the environment or human health (Table 5.3).

   Health-related guidelines exist for 26 of those 48 organic chemicals; no definitive statement could be made for the remaining 22 chemicals for which Canadian or World Health Organization guidelines do not exist.

2) The MOE drinking water program monitored 30 of the 48 organic chemicals later identified by the NRTC as being of concern in water. Of those 30 chemicals, 16 have been identified in treated water at the Niagara area water treatment plants in Ontario. Of these 16 chemicals, 11 have guidelines; five do not.

3) The MOE drinking water monitoring program did not include 18 of the 48 organic chemicals later identified by the NRTC in its Group I, IIA and IIB lists (Table 5.6). Of these 18 compounds, five have guidelines and 13 do not.

4) A total of 37 organic chemicals were found in Niagara area drinking water during the drinking water monitoring program; 16 of these chemicals also appear on the NRTC's Group I, IIA or IIB lists, while the remaining 21 do not. These 37 chemicals are presented below.

a) Chemicals with drinking water guidelines:

Benzene (WHO)
Bromoform (MOE/CAN)
Carbon tetrachloride (WHO)
Chlorodibromomethane (MOE/CDN)
Chloroform (WHO)
1,4 Dichlorobenzene (MOE/CDN)
Dichlorobromomethane (MOE/CAN)
Lindane (MOE/CDN/WHO)
Heptachlor epoxide (MOE/CDN/WHO)
Tetrachloroethene (WHO)
Trichloroethene (WHO)

b) Chemicals without drinking water guidelines:

Acetone*
Benzaldehyde*
BHC-(alpha)
Butanal*
t-Butanol*
Chlorotoluene*
Dibromomethane*
Dichloroiodomethane*
Diethyl ether*
Dimethyl disulphide*
Ethylbenzene
Heptanone*
Hexanal*
Hexane*
Isopropanol*
Methyl ethyl ketone*
Methylene chloride
Pentane*
Styrene
Tetrahydrofuran*
Toluene*
1,1,4-Trichlorobutadiene*
1,1,1-Trichloroethane*
Trichlorophenol
m-Xylene*
o- or p-Xylene*

* - Not on NRTC Lists I, IIA and IIB

Of the 37 chemicals detected, 11 have established drinking water guidelines (table a) above). None of these guidelines was exceeded and consequently there appears to be no immediate concern regarding their impact on human health.

5) A total of 26 of the 37 organic chemicals detected in Niagara area drinking water do not have established drinking water guidelines (table b) above).

Five of these 26 also appear in the NRTC Group I, IIA or IIB lists. The remaining 21 (indicated by *) are not listed in the NRTC Groups I, IIA or IIB (Table 5.7). Of these 21 chemicals, 10 were considered in 1981/82 by the International Joint Commission (IJC) to be of minimal concern to human health (Table 5.3), based on their toxic properties and the levels reported in ambient water up to 1981. Currently, information required to conduct health effects assessments is being compiled for the remaining 11 compounds.

6) The Niagara River drinking water monitoring program was not designed to assess the efficiency of unit processes within the treatment plants. Therefore, no conclusions can be made about the removal or addition of trace organics in these processes.

## RECOMMENDATIONS

The Canada-Ontario Agreement (COA) Board of Review endorses the recommendations made in the final report of the Niagara River Toxics Committee (NRTC) relating to the clean-up of discharges of chemicals to the Niagara River because of the impact of these discharges on drinking water in the area. Consequently, the Board also supports the Committee's call for the implementation of programs to reduce the discharge of those chemicals.

The COA Board of Review recommends:

1) that monitoring be undertaken in both raw and treated drinking water for the 18 chemicals in NRTC Groups I, IIA and IIB, that are not already monitored at Niagara area water treatment plants:

- Benz(a)anthracene
- Benz(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Bis(2-ethylhexyl)phthalate
- Chloronaphthalene
- Chrysene
- Dibenz(a,h)anthracene
- Dichloronaphthalene
- Dioctylphthalate
- Fluoranthene
- Hexachlorobutadiene
- Pentachlorophenol
- Phenol
- Pyrene
- Silvex (2,4,5-TP)
- 2,4-D
- 2,4,5-T;

2) that criteria documents be prepared to determine if drinking water guidelines are necessary for the five organic chemicals in the NRTC Groups I, IIA and IIB, found in treated water, for which guidelines do not exist:

- Alpha-BHC
- Ethyl benzene
- Methylene chloride
- Styrene
- Trichlorophenol

In addition, any chemicals identified in treated water as a result of the monitoring in Recommendation 1, for which guidelines do not exist, should be added to this list;

3) that human health hazard assessments be conducted for the following 11 organic chemicals which were identified in treated water samples during the monitoring programs and for which guidelines do not exist. These chemicals are not included in the NRTC Grcups I, IIA or IIB, have not been assessed by the IJC in the past as being of minimal concern for human health and for which health effects information is currently being compiled. These 11 compounds are:

- Benzaldehyde
- Butanal
- Chlorotoluene
- Dibromomethane
- Dichloroiodomethane
- Dimethyl disulphide
- Heptanone
- Hexanal
- Methyl ethyl ketone
- Tetrahydrofuran
- 1,1,4-Trichlorobutadiene;

4) that drinking water guidelines for tetrachlorodibenzo-p-dioxins, particularly the 2,3,7,8 isomer, be developed as soon as possible. This recommendation is made in recognition of the highly toxic nature of TCDD and although it was not found in drinking water, it was found as a single, extremely low level occurrence in raw water.

5) that the NRTC chemicals of concern lists (Groups IIC through IIG and III) be re-evaluated to identify those chemicals which may, if present in drinking water, impact on human health. Furthermore, the IJC Health Effects Committee should update its 1982 assessments taking into account recently published data;

6) that sampling and analytical protocols, where they do not already exist, be developed and standardized for those compounds for which monitoring is deemed necessary;

7) that raw and treated water monitoring programs for trace organics in the Niagara area be continued and, in some cases, expanded. Frequency of sampling should be of the order of once per month and the range of chemicals to be analyzed should include at least all NRTC Group I, IIA and IIB chemicals deemed to be of human health concern;

8) that the MOE's proposed Drinking Water Surveillance Program, for monitoring trace organic and inorganic compounds at selected municipal water treatment plants across Ontario, be implemented as soon as possible and that water treatment plants in the Niagara area be considered as high priority candidate sites;

9) that the provincial and federal governments continue their research programs to investigate the availability and effectiveness of alternative water treatment systems for the removal of trace organics from drinking water, such as MOE's pilot plant work at Niagara Falls, Ontario.

## INTRODUCTION

During the past decade, concerns have arisen that chemical contaminants, present in the Niagara River, could affect the drinking water supplies in those communities that draw their supply directly from the Niagara River. These chemicals were believed to originate primarily at the chemical industries and waste disposal sites in and around Niagara Falls, New York.

In response to those concerns, the Niagara drinking water monitoring program was undertaken by the West Central Region of the Ontario Ministry of the Environment, with assistance from Environment Canada. The program, which was established in 1978, comprised as comprehensive a selection of chemicals as was practicable at that time and incorporated state-of-the-art procedures for sampling, analysis and quality assurance/quality control.

In addition, Health and Welfare Canada carried out a research program on chemical contamination and mutagenicity in the Great Lakes basin. This study included the water treatment plants at Fort Erie and Niagara Falls.

The Niagara River Toxics Committee (NRTC) was formed in early 1981 to oversee a coordinated study on toxic substances pollution in the Niagara River. Ambient waters were assessed for water quality, but evaluation of drinking water was not included in the NRTC program. In essence, the NRTC assessed potential sources of contaminants and the extent to which the Niagara River water, sediment and biota were affected by these contaminants.

Since the terms of reference of the NRTC did not extend to drinking water, a group of scientists and engineers representing the Ontario Ministry of the Environment (MOE), Environment Canada (DOE) and Health and Welfare Canada (HWC) was assembled to produce a report on Canadian public drinking water supplies along the

Niagara River under the auspices of the Canada - Ontario Agreement Board of Review.

This report compiles the trace organics data from three water treatment plants along the Niagara River for a one-year period. The data were evaluated in light of existing guidelines and the NRTC's findings that certain trace organics require attention.

Recommendations are made for actions to fill gaps found in the data and for the development of necessary background documentation for developing guidelines or health risk assessments where deemed necessary.

# 2.0 THE NIAGARA RIVER

## 2.1 The Resource

The Niagara River connects Lake Erie to Lake Ontario, a distance of 58 kilometres (37 miles). The river has an average flow of 5700 cubic meters per second (200,000 cubic feet per second) and provides 83 percent of the total tributary flow to Lake Ontario. The Horseshoe and American Falls comprise the Niagara Falls and divide the river into upper and lower reaches. The river is used for municipal and industrial water supplies, receiving wastewater discharges, power generation, commerce and recreation, and the area is a major tourist attraction.

The Niagara River directly serves as a source of municipal drinking water for a population of more than 400,000 along the river. The City of Buffalo municipal water plant, which obtains water at the junction of Lake Erie and the Niagara River, services an additional 530,000 people. The river, in return, is a repository for the treated municipal and industrial wastes.

During the early part of the century, the Niagara frontier developed rapidly. The proximity to a source of cheap electrical power and water for use in industrial processing led to the highly industrialized development of this area, particularly on the United States side. The Niagara frontier today contains numerous steel, petrochemical and chemical manufacturing industrial complexes.

While this development led to economic benefits for society (e.g. creating jobs, producing cheaper products etc.), it has proven to be the cause of environmental problems for the river and surrounding area, and has given rise to concern about potential impacts on human health.

## 2.2 Pollution in the River

Pollution in the Niagara River has been a major concern at all government levels since the early 1950's. The Niagara River continues to be the focus of numerous studies and reports by the Canada-Ontario Agreement Board of Review, the International Joint Commission (IJC), the Niagara River Toxics Committee (NRTC) and by individual federal, state and provincial agencies in both countries. These reports, as well as those of public interest groups such as the New York Public Interest Research Group and Pollution Probe, have caused a heightened public awareness and sensitivity to issues involving the Niagara River.

Early pollution concerns in the river involved conventional parameters: bacteria, phenol, oil, iron, phosphorus and chloride, as well as general discolouration. Most of these conventional problems have been reduced significantly over the past decade due to improved treatment of municipal and industrial waste waters.

Millions of dollars have been, and continue to be, spent by both government and industry in implementing and evaluating remedial programs.

Today, attention is focused on trace organic chemicals in the Niagara River and in Lake Ontario, and their effects on human health and the ecosystem. These substances originate directly from municipal and industrial discharges and indirectly from major waste disposal sites along the river.

There is concern about the possible long-term health effects of these organic substances at trace levels. However, given the present state of scientific knowledge, the ability to detect these compounds has developed more rapidly than the ability to identify specific adverse effects on human health and the environment.

In many cases, neither the scientific data nor the basis for establishing the environmental and human health significance of these compounds exists. Developing a scientific data base is expensive and its interpretation is difficult.

The presence of trace organic chemicals in the river is probably not a new phenomenon. The development of more sophisticated equipment and methodologies over the years has led to increasing detection capability, thus enabling previously undetected chemicals to be identified at very low concentrations.

## 2.3 Role of Government

The Governments of Canada, the United States, Ontario and New York State all recognize the international context within which pollution of the Niagara River must be considered. The Boundary Waters Treaty of 1909 was signed to deal with the issues of the day, which were the first Great Lakes diversion and allocation of the water in the Great Lakes Basin. The signing of that Treaty eventually led to the formation of the International Joint Commission (IJC), which consists of representatives of Canada and the United States. The Canada/United States Agreement on Great Lakes Water Quality of 1972 was subsequently developed along with its revision in 1978.

The objective of the Agreement is to restore and maintain the chemical, physical and biological integrity of the waters of the Great Lakes Ecosystem. In the same spirit and with a similar objective, the first Canada-Ontario Agreement was signed in 1971. This action co- ordinated Canadian and Ontario government efforts on pollution control in the Great Lakes.

In Canada, it is the provinces' responsibility to ensure an adequate and safe supply of drinking water. The federal government provides leadership in ensuring that adequate guidelines exist for drinking water quality, especially those relating to the protection of human health. A major federal/ provincial collaborative venture is the Federal/Provincial Working Group reviewing "Guidelines for Canadian Drinking Water Quality".

Local municipalities are responsible for supplying drinking water which meets established health related guidelines. The jurisdiction of local Medical Officers of Health includes the safety of drinking water supplies.

The concern of governments and the public about pollution in the Niagara River, and common interest in restoring the health and vitality of the river, led the federal, state and provincial environmental agencies to cooperate in a multi-agency investigation of toxic chemicals entering the river. In February 1981, the Niagara River Toxics Committee (NRTC) was established to oversee and coordinate this program. The committee's membership consists of representatives from Environment Canada, the Ontario Ministry of the Environment, the United States Environmental Protection Agency and the New York State Department of Environmental Conservation. The final report of the NRTC was released in November, 1984.

In addition, the Canada-Ontario Agreement Board of Review established a committee to address the issue of trace organics in drinking water in the Niagara area and their implications for human health. This topic was not covered in the NRTC report, but is of great interest to Government and the public alike. This report presents the findings of the COA committee.

# 3.0 NIAGARA RIVER DRINKING WATER PROGRAM

## 3.1 Provincial/Federal Programs

### 3.1.1 Provincial Program

In 1974, water treatment plants in the former counties of Welland and Lincoln became the responsibility of the newly created Regional Municipality of Niagara. Monitoring for conventional water quality parameters in the raw and treated* water at water treatment plants in the Niagara Peninsula is routinely carried out by the Regional Municipality, with analyses being carried out at the Ministry of the Environment Laboratories in Toronto.

These laboratories have also developed the capability for the detection of trace organic substances in water samples. In the late 1970's, the Niagara River drinking water monitoring program, a sampling and analysis program for trace organic contaminants, was established by the West Central Region of the Ministry of the Environment. Samples for analysis were collected by staff of the Ministry of the Environment's, Welland District Office, and transported to the Ministry's Toronto Laboratories for analysis of most pesticides and trace organics.

The expanded drinking water sampling and analysis program started initially at Niagara Falls and Niagara-on-the-Lake water treatment plants; it was subsequently expanded to include plants in Fort Erie and St. Catharines. Results from the St. Catharines treatment plant are not included in this report, since the Niagara

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*The terms "treated water" and "drinking water" are synonymous and refer to the finished product (i.e. treated drinking water) delivered by the water treatment plants to the community. Raw water refers to water collected at these plants but prior to any treatment steps.

River is not the source of water supply of this treatment plant. A detailed description of the three water treatment plants is presented in Appendix B.

There were three objectives behind the development of the program:

1. to evaluate the extent of contamination by trace organics at water treatment plants in the Niagara area.

2. to assess the effectiveness of monitoring programs for evaluating water quality.

3. to revise existing monitoring programs, if needed.

### 3.1.2 Federal Program

Health and Welfare Canada has carried out a program on chemical contamination and mutagenicity in the Great Lakes Basin. During 1982 the program included Niagara Falls and Fort Erie. The purpose of this research was to determine the different levels of chemicals and mutagens found in water before and after treatment. Chemical data obtained in this program from Niagara Falls and Fort Erie were used in this report.

Environment Canada's Inland Waters Directorate has been collecting and analyzing raw water samples from Niagara-on-the-Lake for contaminants since 1979. The purpose of this program is to determine trends in chemical levels in both raw water and suspended sediments, as well as to assist in the determination of loading rates of toxic chemicals into Lake Ontario. The evaluations provided in these studies will not be discussed in this report; however, the data collected were used in the formulation of a list of chemicals of concern identified by the NRTC and addressed in Chapter 5 of this report.

## 3.2 Sample Locations and Methods

### 3.2.1 Niagara-on-the-Lake.

Samples of raw water were collected using the sampling equipment of Environment Canada's Inland Waters Directorate. The equipment consists of a line extending 30 meters into the Niagara River from the Canadian shore at a point 6 meters above the bottom and 13 meters below the surface. The line is made of polypropylene and is attached to other plastic tubing with stainless steel fittings. The pump is made of polypropylene. Prior to sampling, the pump was turned on and the water allowed to run for at least ten minutes before the sample was obtained.

The treated water sample came from a continuously running tap on the supply main from the plant to the town. Plumbing in the line from the main to the tap is copper with lead/tin soldered joints.

### 3.2.2 Niagara Falls

Raw water samples were obtained from a continuously running line from a pump in the wet well ahead of the low lift pumps. The line from the sampling pump is copper with lead/tin soldered joints, except for a small amount of plastic tubing where the line was fed through difficult-to-reach areas.

The treated water samples were taken from a continuously running tap located directly on the 24 inch outlet main.

### 3.2.3. Fort Erie (Rosehill)

Prior to June 1982, raw water samples were obtained from the low lift forebay using a dedicated sampling device. This device consisted of a weighted metal bucket in which the sample bottle was secured. The device was then lowered into the water. Water touching the bucket would not enter the sample bottle. Since June 1982, sampling has been carried out from a tap located on the

discharge side of the low lift pumps, prior to chlorination. The line from the inlet main to the tap is made of copper and is about two feet long. Water was allowed to run for at least five minutes prior to sampling.

Treated water samples were collected from a tap on the outlet main. Water was allowed to run for about 20 minutes prior to sampling.

## 3.3 Sample Handling

New or specially cleaned glass bottles were used for each sample in order to minimize the possibility of contamination. At each location, one sample of each of raw and treated water was taken in a dark one-litre, acetone-rinsed bottle for organo-chlorine pesticide analysis. Samples to be analysed for pesticides were filled only to the shoulder with as little turbulence during sampling as possible. For volatile organics, two new, one-litre bottles were filled slowly and allowed to overflow to ensure no air was trapped in the bottle. These bottles were then capped tightly.

## 3.4 Sampling Limitations

It is important to recognize some of the difficulties and limitations of the sampling procedures used in assessing the data presented in this report. Increasing familiarity and experience in sampling for trace organics are continually leading to improvements in procedures. Recently developed standard sampling protocols require all drinking water sampling lines to be copper. Polypropylene or other plastic sampling lines, in contact with water, may contaminate the sample with traces of specific organic compounds. A lack of a uniform sampling methodology can produce results which are not directly comparable. It has been noted in recent studies that a constant water flow rate, for an extended period of time, may be required to clear sedimented material from lines not run continuously; altering flow may also cause disturbances in the quality of the water sampled.

It is also necessary to recognize that the sampling regime used in this study was not designed to evaluate treatment plant removal efficiencies. Since, in this study the raw water sample cannot be temporally related to the treated water sample, it is not appropriate to compare levels of contaminants in raw and treated water samples and to calculate removal and/or generation of contaminants as a result of treatment processes.

## 3.5 Chemical Analysis

Water samples were analysed for volatile organic substances using the Gas Chromatograph/Mass Spectrometer (GC/MS), purge and trap technique. Detailed analytical procedures are outlined in Appendix E. A very wide range of volatile organic compounds is detectable by this method and some typical compounds are shown in Appendix F. If any of these compounds, or any others which are analyzable by this method, are present in the sample, they will be detected and identified by mass spectrometry. Any identified contaminants found during routine scans would be followed up and identified. Organo-chlorine pesticides that may be detected are also shown in Appendix F. These were analysed by Gas Chromatograph/Electron Capture Detector (GC/EC). Due to the variable nature of organochlorine pesticides, the detection limit for these varies from compound to compound.

Individual isomers of trichlorophenol were analysed by GC/EC. The chemical class of chlorinated dibenzo-p-dioxins was analysed by GC/MS. These chemicals and their detection limits are listed in Appendix F.

# 4.0 DATA PRESENTATION

## 4.1 Data Base Considerations

The chemicals discussed in this report are limited to those detected during the following periods:

A) January - December 1982 for the plants at Niagara Falls and Fort Erie (the latest complete year of data available for the preparation of this report);

B) Mid-July 1981 - mid-July 1982 for the plant at Niagara-on-the-Lake (The last complete 12 month period of this plant's operation).

Where possible, all available data sets from all sources were used. Health and Welfare Canada conducted drinking water analyses in 1982 at the Fort Erie and Niagara Falls water treatment plants and these data have been used in this report. Other drinking water samples were analysed by Health and Welfare Canada at plants in the Niagara area; however, these were done outside the period considered in this report.

Table 4.1 presents a summary of those chemical compounds detected in either raw or treated water at the three water treatment plants in the Niagara area during this program. The table displays the range of concentrations detected at each plant during the periods mentioned above. Where they exist, Canadian or World Health Organization drinking water guidelines are shown on the right hand side. Implications for human health of those chemicals (with guidelines), detected in treated water are presented in Chapter 5.

A complete data set for the period of study for all treatment plants is presented in Appendix A of this report. Data are presented individually for each treatment plant. No attempt has been made to establish relationships between plants.

Table 4.1

ORGANIC CHEMICALS DETECTED IN WATER IN THE NIAGARA AREA WATER TREATMENT PLANTS

Concentrations in ug/l

| CHEMICAL | Fort Erie | | Niagara Falls | | Niagara-on-the-Lake | | GUIDELINES | |
|---|---|---|---|---|---|---|---|---|
| | R | T | R | T | R | T | CDN (MAC) | WHO |
| ACETONE | ND-5.1 | 0.2-0.5 | ND-7.4 | ND-8.3 | ND-0.2 | ND-0.5 | | |
| ALPHA-BHC | ND-0.006 | ND-0.004 | ND-0.009 | ND-0.009 | ND-0.009 | ND-0.014 | | |
| ALPHA-CHLORDANE | ND | ND | ND | ND | ND-0.003 | ND | See Chlordane | |
| BENZALDEHYDE | ND | ND | ND | ND | ND | ND-0.1 | | |
| BENZENE | ND-0.3* | Tr-0.3 | ND-0.3* | ND-1.4 | ND-0.1 | ND-0.7 | | 10 (Re) |
| BROMOFORM | ND | 0.3-0.4 | ND | ND*-0.5 | ND | Tr-0.3 | 350 (THM) | |
| BUTANAL | ND | ND | ND | ND | ND | ND-Tr | | |
| t-BUTANOL | ND | ND | ND | ND-0.2 | ND | ND | | |
| CARBON TETRACHLORIDE | ND | ND | ND | ND-1.0 | ND-0.1 | ND-0.3 | | 3 (Te) |
| CHLORDANE | Only isomer found was alpha-chlordane. | | | | | | 7.0 | 0.3 (Te) |
| CHLORODIBROMOMETHANE | ND-0.1 | 3.5-5.0* | ND | 1.3*-10.1 | ND-0.1 | 2.1-6.0 | 350 (THM) | |
| CHLOROFORM | ND-1.3* | 15.4-17.9 | ND-4.8* | 4.5-25.2 | Tr-2.7 | 4.6-21.1 | 350 (THM) | 30 (Re) |
| CHLOROTOLUENE | ND | ND | ND | ND | ND | ND-Tr | | |
| p-CHLOROTRIFLUOROTOLUENE | ND | ND | ND | ND | ND-Tr | ND | | |
| DIBROMOMETHANE | ND | ND | ND-0.1 | ND-0.2 | ND | ND | | |

Table 4.1

ORGANIC CHEMICALS DETECTED IN WATER IN THE NIAGARA AREA WATER TREATMENT PLANTS

Concentrations in ug/l

| CHEMICAL | Fort Erie | | Niagara Falls | | Niagara-on-the-Lake | | GUIDELINES | |
|---|---|---|---|---|---|---|---|---|
| | R | T | R | T | R | T | CDN (MAC) | WHO |
| 1,4-DICHLOROBENZENE | ND | ND-Tr* | ND | ND-Tr* | ND | ND | | 0.1 (Re)[a] |
| DICHLOROBROMOMETHANE | ND-Tr | 6.9-10.2* | ND | 3.7-13.3 | ND-0.3 | 2.6-18.6 | 350 (THM) | |
| 1,2-DICHLOROETHANE | ND | ND | ND-0.1 | ND | ND | ND | | 10 |
| DICHLOROIODOMETHANE | ND | ND | ND | ND-0.1 | ND | ND-0.2 | | |
| DICHLOROMETHANE** (methylene chloride) | ND-1.2* | ND-4.3* | ND-44.0 | ND-31.0 | ND-50.0 | ND-23.0 | | |
| DIETHYL ETHER | ND | ND-Tr | ND-0.8 | ND | ND-Tr | ND | | |
| DIMETHYL DISULPHIDE | ND-0.1 | ND | ND | ND-0.1 | ND-Tr | ND | | |
| DIMETHYL SULPHIDE | ND-0.1 | ND | ND | ND | ND | ND | | |
| ETHANOL | ND | ND | ND-Tr | ND | ND | ND | | |
| ETHYLBENZENE | ND | ND-0.1* | ND | ND-0.2 | ND-0.1 | ND-0.1 | | |
| GAMMA-BHC (Lindane) | ND-0.002 | ND | ND-0.007 | ND-0.001 | ND-0.003 | ND-0.001 | See Lindane | |
| HEPTACHLOR EPOXIDE | ND | ND | ND | ND-0.001 | ND | ND | 3.0 | 0.1 (Re) |
| HEPTANONE | ND | ND | ND-0.3 | ND-0.3 | ND | ND | | |
| HEXANAL | ND-0.3 | ND | ND-1.1 | ND-0.8 | ND-0.3 | ND-0.5 | | |

Footnote: ** High levels of dichloromethane detected (single occurrence) may be due to contamination in the laboratory.

Table 4.1

ORGANIC CHEMICALS DETECTED IN WATER IN THE NIAGARA AREA WATER TREATMENT PLANTS

Concentrations in ug/l

| CHEMICAL | Fort Erie | | Niagara Falls | | Niagara-on-the-Lake | | GUIDELINES | |
|---|---|---|---|---|---|---|---|---|
| | R | T | R | T | R | T | CDN (MAC) | WHO |
| HEXANE | ND-0.2 | ND-Tr | ND-0.3 | ND-0.3 | ND-0.2 | ND-0.1 | | |
| HEXACHLOROBENZENE | ND | ND | ND | ND | ND-0.001 | ND | | 0.01 (Re) |
| ISOPROPANOL | ND-0.1 | ND-0.2 | ND-0.6 | ND-0.7 | ND | ND | | |
| LINDANE (see Gamma-BHC) | | | | | | | 4.0 | 3.0 (Re) |
| METHYL ETHYL KETONE | ND-0.1 | ND | ND-0.1 | ND-0.3 | ND-0.1 | ND | | |
| METHYL FURAN | ND | ND | ND-0.1 | ND | ND | ND | | |
| PCB | ND | ND | ND-0.025 | ND | ND-0.030 | ND | 3.0 (MOE, interim) | |
| PENTANE | ND | ND | ND-0.9 | ND-1.1 | ND | ND | | |
| STYRENE | ND-0.2* | ND-0.3* | ND-0.3* | ND-0.5* | ND | ND-Tr | | |
| TCDD | ND | ND | ND-0.000017 | ND | ND-0.000010 | ND | | |
| 1,1,2,2-TETRACHLOROETHANE | ND | ND | ND-0.6 | ND | ND | ND | | |
| TETRACHLOROETHENE | ND-0.1 | ND-0.1 | ND-0.2 | ND-0.1 | ND-0.1 | ND-0.1 | | 10 (Te) |
| TETRAHYDROFURAN | ND | ND | ND-0.1 | ND | ND-0.4 | ND-0.7 | | |
| TOLUENE | ND-0.2 | Tr*-0.4 | ND-0.2 | ND-1.3 | ND-0.5 | ND-0.7 | | |
| 1,1,4-TRICHLOROBUTADIENE | ND | ND | ND | ND-0.3 | ND | ND-0.7 | | |

Table 4.1

ORGANIC CHEMICALS DETECTED IN WATER IN THE NIAGARA AREA WATER TREATMENT PLANTS

Concentrations in ug/l

| CHEMICAL | Fort Erie | | Niagara Falls | | Niagara-on-the-Lake | | GUIDELINES | |
|---|---|---|---|---|---|---|---|---|
| | R | T | R | T | R | T | CDN (MAC) | WHO |
| 1,1,1-TRICHLOROETHANE | ND-Tr | ND | ND-0.1 | ND | ND-0.3 | ND-0.1 | | |
| TRICHLOROETHENE | ND | ND | ND-0.2 | ND-0.1 | ND-0.2 | ND-0.1 | | 30 (Te) |
| 2,3,5-TRICHLOROPHENOL | ND | ND | ND | ND-0.1 | ND-0.1 | ND-0.1 | | |
| 2,3,6-TRICHLOROPHENOL | ND | ND | ND | ND-0.1 | ND-0.1 | ND | | |
| 2,4,6-TRICHLOROPHENOL | ND | ND | ND | ND | ND-0.2 | ND-0.1 | | a |
| XYLENE (m-) | ND | ND-0.1* | ND-Tr | ND-0.5 | ND-0.1 | ND-0.3 | | 10.0/0.1 (Re) |
| XYLENE (o- or p-) | ND-0.1 | ND-0.1 | ND-0.2 | ND-0.4 | ND-0.2 | ND-0.2 | | |

a: Based on Organoleptic (taste & odour) Properties
CDN: Ontario and Canadian Drinking Water
MDE: Ontario Guidelines
MAC: Maximum Acceptable Concentration
ND: Not Detected
R: Raw Water
Re: Recommended
T: Treated Water
Te: Tentative
Tr: Detected Below Quantifiable Limit
THM: Total Trihalomethanes
WHO: World Health Organization
*: Health and Welfare Canada Values

# 5.0 GUIDELINES: IMPLICATIONS FOR HUMAN HEALTH

## 5.1 Derivation of Guidelines

It is worthwhile to review the process by which guidelines or standards are established for chemicals in drinking water.

Guideline values set for drinking water, as derived by the specific agencies, are based on subjective judgements by scientists after careful and thorough consideration of international scientific data. The task of setting guideline values for water is based upon several factors. Foremost, it must be decided whether the scientific data, upon which the judgement will be made, are valid. Following that, the data deemed acceptable must be evaluated and the significance of these data for humans must be estimated. Most research on the toxicity of chemicals is carried out using laboratory animals.

Estimation of the hazard to man of non-carcinogenic chemicals is usually based on the lowest no-observed-adverse-effect-level determined in animal studies with the application of specific safety factors. These safety factors, usually ranging from 10 to 1,000, allow for species variability, individual variation and interactive effects of chemicals. Frequently, data evaluation and the application of safety factors result in the development of an acceptable daily intake (ADI). Dermal and pulmonary exposures are also considered when significant. Since water is only a portion of a person's daily intake, between 1% and 20% of the ADI value is usually used to set the guideline value for drinking water, depending on the relative contribution of waterborne contaminants to man's total daily intake. Guidelines are then based on consumption of 1.5 to 2.0 litres of water a day for a 60 to 70 kg individual.

For carcinogenic chemicals, risk assessments are considered; one of several mathematical dose-effect models is frequently employed to derive risk values.

The models used (e.g. margin of safety, one-hit, two-step etc.) all assume that a calculable risk exists regardless of the size of the dose. At low dose levels, a wide variation in calculated numbers can occur, even when starting with the same original data, depending upon the model used. This can lead to different acceptable levels and guidelines being developed by different regulatory agencies. In addition, in the publication "Guidelines for Drinking Water Quality, Vol. 1, Recommendations, World Health Organization, Geneva 1984" it is stated:

> "The importance of chemical contamination involving trace amounts of substances...must be assessed in relation to the other health risks associated with drinking water, e.g. transmission of waterborne disease, and the relative importance attached to these risks must be decided by taking into account the local or regional situation. In such situations, the risks associated with low levels of organic compounds, e.g. trihalomethanes (formed during disinfection), may be smaller than the risk they are eliminating so the authority responsible for public health should set values higher than those given in this document in order to benefit the health of its consumers."

Occasionally, chemicals (e.g. chlorophenols) impart to water an unpleasant odour or taste (organoleptic properties) or an undesirable colour. In this situation, the guideline value may be set based on these properties of the chemical and not on its toxicological properties, provided that the established level for toxicological effects significantly exceeds the acceptable level for colour, odour and taste.

The public should be aware that some of the water guidelines published internationally do not pertain solely to drinking water. The United States Environmental Protection Agency, for example, sets separate guidelines for ambient water quality and for drinking water. Their published Ambient Water Quality Criteria,

cited in Appendix C, indicate concentrations of chemicals in ambient water that would not lead to an accumulation of chemicals in fish and/or shellfish that in turn could be hazardous to health for persons eating these aquatic organisms and also drinking water from that body of water.

Therefore, guidelines are established after ensuring the validity of the scientific data, taking into account individual and species differences, and considering the overall toxicity of the chemical. Guideline values, as set forth by the agencies, are based on the assumption that there should be no significant risk to the health of individuals who, for a lifetime consume water that contains chemicals at that concentration. They also apply to the use of water for domestic purposes and personal hygiene. Occasional consumption of drinking water moderately in excess of 2 litres per day, with chemical concentrations slightly in excess of the guideline value, are unlikely to pose significant health risks.

## 5.2 Guideline Limitations

There are three limitations to the guideline values discussed in Section 5.1.

First, they are based on life-time (chronic) consumption and do not apply directly to short-term (acute) consumption of water containing high concentrations of contaminants. The latter exposure may occur as a result of an unusual or sudden contaminant discharge into a water system. If such a situation arises, it must be treated as a special case. Although man can tolerate higher contaminant levels if exposure is short-term rather than long-term, prompt remedial measures are nevertheless required.

Second, guidelines do not suggest that communities or society may be allowed to contaminate water up to the concentration given by the guideline. It is prudent policy to limit human exposure to chemicals whenever reasonable and possible.

Third, guidelines are not carved in stone; they are the best opinion based on the information available at the time they are set. New scientific data can result in a change in a guideline; hence, guidelines are periodically reviewed by all jurisdictions.

## 5.3 Drinking Water Guidelines

Guidelines for drinking water quality in Canada are established jointly by Health and Welfare Canada and the Provinces. Those in the United States of America are set by the Environmental Protection Agency. Internationally, the World Health Organization (WHO) establishes drinking water guidelines. The guidelines can be set only if sufficient toxicological data are available for that chemical. These guidelines suggest that persons consuming water containing chemicals at or below the concentrations indicated, every day for a lifetime, would suffer no significant health problems attributable to consumption of that chemical.

For the purpose of this report only Canadian, Ontario and WHO drinking water guidelines were used.

## 5.4 Chemicals Of Concern

The NRTC grouped the chemicals that were detected in ambient Niagara River water during the course of its study into three Groups. Group I contains the chemicals that were deemed to be of immediate health or environmental concern because they were found at ambient levels exceeding or equal to the most stringent current ambient criteria. Group III contains the chemicals deemed to be of minimal immediate health or environmental concern. Group II contains all other detected chemicals, for which further work is required in order to determine their environmental and human health significance.

Six criteria were considered by the NRTC; one was based on human health (USEPA National Interim Drinking Water Standards) and five were based on the aquatic environment.

Group II was further subdivided into seven subgroups, IIA to IIG, of decreasing concern. Groups IIA and IIB contain chemicals that have undergone assessment by the IJC's Committee on the Assessment of Human Health Effects of Great Lakes Water Quality (HEC) and have been found to be of potential concern to human health based on data available up to 1981. Groups IIC - IIG contain the remaining chemicals that are either of no immediate health concern or were not addressed by the HEC.

The NRTC Report thus identified three groups of chemicals, I, IIA and IIB, that could affect drinking water quality.

Certain of those chemicals of concern in water have established drinking water guidelines. These chemicals are as follows:

Aldrin: Aldrin is an organochlorine insecticide which has been banned for agricultural use in Ontario since 1969. It has not been detected in drinking water in the Niagara River. The World Health Organization (WHO) drinking water guideline of 0.03 ug/l is set for either aldrin or dieldrin or their combined sum. The similar Canadian/ Ontario value is 0.7 ug/l.

Alpha-Chlordane: Chlordane, an organochlorine insecticide, is a mixture of several isomers including the alpha isomer. Alpha-chlordane was not detected in drinking water. Guideline values set for chlordane at 0.3 ug/l (WHO) and 7.0 ug/l (Canada/Ontario) include this isomer.

Benz(a)pyrene: Benz(a)pyrene is one of the family of polycyclic aromatic hydrocarbons (PAHs). Others in that family include benz(a)anthracene, anthracene, pyrene, fluoranthene, etc. The principal source of contamination by these chemicals is imcomplete combustion (domestic, industrial and

natural). Niagara area treated water samples have not been analyzed for PAH's. WHO has set a tentative guideline of 0.01 ug/l for benz(a)pyrene.

Benzene: This chemical is a well known solvent and a suspected human carcinogen. It was detected in treated water samples (max. 1.4 ug/l). Detected levels were below the guideline set by WHO at 10 ug/l.

Bromoform: This compound is a trihalomethane, similar in structure to chloroform. Bromoform was found in treated water at levels up to 0.5 ug/l. Guidelines for this compound are included under trihalomethanes.

Carbon tetrachloride: Carbon tetrachloride is a widely used chemical solvent. Its presence in Niagara area drinking water (max. 1.0 ug/l) is below the WHO tentative guideline (3.0 ug/l).

Chlordane: This organochlorine compound is used as a broad spectrum, contact insecticide. It was not detected in Niagara area drinking water. The guidelines established by WHO and Canada/Ontario are 0.3 and 7.0 ug/l, respectively. These guideline values cover the combined toxicity of all isomers.

Chlorodibromo-methane This compound is one of the group of trihalomethanes. It was detected at levels up to 10.1 ug/l in drinking water. Its guidelines are discussed under trihalomethanes.

Chloroform: This compound is one of the trihalomethane group of compounds. Niagara area drinking water was found to contain up to 25.2 ug/l. The Canada/ Ontario guideline for total trihalomethanes is 350 ug/l in drinking water, (see trinalomethanes). The WHO recommended guideline for chloroform alone is 30 ug/l.

2,4-D: This chlorophenoxy herbicide was not monitored during the drinking water program. The Canada/Ontario and WHO guidelines are all 100 ug/l.

1,2-Dichlorobenzene: Treated Niagara area water samples did not contain detectable levels of this chlorinated benzene. The WHO guideline of 0.3 ug/l for this compound is based on odour threshold.

1,4-Dichlorobenzene: This compound was detected in the drinking water, but at trace levels below the quantification limit of 0.1 ug/l. A guideline for 1,4-dichlorobenzene of 0.1 ug/l has been established by WHO based on odour threshold.

Dichlorobromomethane: This chemical is one of the trihalomethane compounds. It was detected in drinking water at levels up to 18.6 ug/l. Guidelines are presented under trihalomethanes.

1,2-Dichloroethane: The compound was not detected in drinking water. The guideline value set by WHO is 10 ug/l.

Dieldrin: This organochlorine insecticide was not detected in drinking water. The guideline for this pesticide is set in conjunction with aldrin. Levels in drinking water should not exceed 0.7 ug/l (Canada) either for dieldrin alone or in

conjunction with aldrin. The WHO guideline for aldrin and/or dieldrin is 0.03 ug/l.

DDD: DDD is an organochlorine insecticide. It was not detected in treated water supplies. Since DDD is a metabolite of DDT, guidelines are given under DDT.

DDE: DDE is an organochlorine insecticide. It was not detected in drinking water. Since DDE is a metabolite of DDT, guidelines are given under DDT.

DDT: Dichloro diphenyl trichloroethane (DDT) has been banned from use in Canada because of its persistence in the environment and its ability to bioaccumulate in aquatic life. DDT was not detected in treated water supplies. The Canadian drinking water guideline established for DDT and its metabolites (DDD and DDE) is 30 ug/l and the WHO recommended guideline is 1.0 ug/l.

Endrin: This organochlorine pesticide has limited use in Ontario. Its presence was not detected in treated drinking water samples from the Niagara area. The Canadian drinking water guideline is 0.2 ug/l.

Gamma-Chlordane: This chemical is the most toxic of the chlordane isomers. It was not detected in drinking water samples. The guideline for chlordane includes the gamma isomer.

Heptachlor: Heptachlor was not detected in the drinking water samples. The guidelines published by the WHO (0.1 ug/l) and Canada (3.0 ug/l) are based on heptachlor and/or its major metabolite, heptachlor epoxide.

**Heptachlor epoxide:** Heptachlor epoxide was detected up to 0.001 ug/l in drinking water. The guidelines published by the WHO (0.1 ug/l) and Canada (3.0 ug/l) are based on heptachlor and its major metabolite, heptachlor epoxide.

**Hexachlorobenzene:** Hexachlorobenzene was not detected in the drinking water samples. The drinking water guideline set by the WHO is 0.01 ug/l.

**Lindane:** The organochlorine pesticide Lindane is composed primarily ( 99%) of the gamma-BHC isomer. The guidelines for Lindane refer strictly to gamma-BHC and not the other isomers: alpha-BHC, beta-BHC, epsilon-BHC, and delta-BHC. Gamma-BHC was detected in treated drinking water samples up to a concentration of 0.001 ug/l. The Canadian and WHO drinking water guidelines for Lindane are 4.0 ug/l and 3.0 ug/l, respectively.

**Polychlorinated biphenyls:** Polychlorinated biphenyls (PCBs) were not detected in drinking water samples. The Ontario Ministry of the Environment's interim guideline is 3.0 ug/l for drinking water.

**Pentachlorophenol:** This compound was not analyzed in Niagara area drinking water samples. The WHO recommended guideline is 10 ug/l.

**Phenol:** No analyses were carried out for phenol in drinking water. The Canadian guideline of 2.0 ug/l is based on organoleptic properties (i.e. odour and taste).

**Silvex:** This compound, also known as 2,4,5 TP, was not monitored in the Niagara area program. The Canadian guideline level has been established at 10 ug/l.

Tetrachloro-dibenzo-p-dioxin: More commonly and erroneously known as "dioxin", tetrachlorodibenzo-p-dioxins (TCDD's) were identified twice in raw water samples, at 0.000010 ug/l and 0.000017 ug/l. The most toxic TCDD congener, 2,3,7,8-TCDD, has not been identified in raw water. None of the tetrachlorodibenzo-p-dioxin isomers have been detected in treated drinking water. A guideline is being considered by federal and provincial experts.

Tetrachloro-ethene: Tetrachloroethene was detected at levels up to 0.1 ug/l in drinking water. WHO has established a guideline of 10 ug/l for this compound.

Trichloro-ethene: Trichloroethene was found in treated water samples from the Niagara area up to a maximum of 0.1 ug/l. WHO has set a tentative guideline of 30 ug/l.

2,4,6-Trichloro-phenol: This compound was detected up to a level of 0.1 ug/l. WHO has issued a guideline of 10.0 ug/l based on health considerations. WHO has also set a guideline at 0.1 ug/l based on odour and taste considerations.

Trihalomethanes: The four most widely occurring trihalomethanes in water are: chloroform, dichlorobromomethane, chlorodibromomethane and bromoform. These chemicals can be created during the chlorination of water. The Canadian drinking water guideline is 350 ug/l for any combination of these four trihalomethanes.

## 5.5 Selective Listings of Chemicals of Concern

The NRTC has developed a series of lists of chemicals of concern in the Niagara River environment as described in Section 5.4. Chemicals of concern from these lists are presented in Tables 5.1 (NRTC Group I) and 5.2 (NRTC Groups IIA and IIB). From these tables, those organic chemicals deemed to be of concern in ambient water by the NRTC, are presented in Table 5.3.

Drinking water guidelines have been established for some of these chemicals; these are shown in Table 5.4. Table 5.5 lists the remaining organic chemicals of concern from Table 5.3 that have no applicable drinking water guidelines. Tables 5.4 and 5.5 also indicate whether or not these chemicals were monitored and, if so, the maximum levels detected. Thus, of 48 organic chemicals identified as being of concern in water, 26 have applicable drinking water guidelines (Table 5.4), and 22 have no guidelines (Table 5.5).

Of the 26 chemicals with guidelines, 21 were monitored in this program and 5 were not; these 5 were not analyzable by the methodologies selected. Of the 22 chemicals without guidelines, 9 were monitored and 13 were not.

Therefore there are a total of 18 chemicals identified as being of concern in ambient water by the NRTC (Groups I, IIA and IIB) but were not monitored in this study. Table 5.6 presents these 18 chemicals, 5 of which have applicable guideline values.

Table 5.7 contains a listing of the organic chemicals that were detected in the treated drinking water during the period of this study, but which do not appear in the NRTC groups I, IIA or IIB. Of these 21 chemicals, 10 have been assessed in the IJC's Committee on the Assessment of Human Health Effects of Great Lakes Water Quality (HEC) 1982 Annual Report and were deemed to be of minimal concern for human health based on their toxic properties and the levels reported in water up to 1981 (Table 5.8).

Table 5.9 contains the 11 chemicals detected in treated drinking water during the Niagara River drinking water monitoring program, but which do not appear in the NRTC Group I, IIA or IIB, or the HEC list. More information is required in order to carry out assessments of the potential human health effects of those chemicals listed in Table 5.9. (See Section 6.1). It should be noted that the HEC assessment was completed in 1982.

Table 5.1

NRTC GROUP I CHEMICALS OF CONCERN* IN THE NIAGARA RIVER

| Group I | Medium of Concern |
|---|---|
| Aldrin | S |
| Antimony | W |
| Arsenic | S |
| Benz(a)anthracene | W |
| Benzene | W |
| Benzo(b)fluoranthene | W |
| Benzo(k)fluoranthene | W |
| Benz(a)pyrene | S,W |
| Beryllium | W |
| BHC - (alpha) | W |
| Bis(2-ethylhexyl)phthalate | S,W |
| Cadmium | B,S,W |
| Carbon tetrachloride | W |
| Chlordane | S,W |
| Chloroform | W |
| Chromium | S,W |
| Chrysene | W |
| Copper | S,W |
| Cyanide | S,W |
| DDD (p,p) | S,W |
| DDE | S,W |
| DDT (p,p) | S,W |
| 1,2-Dichloroethane | W |
| Dieldrin | S,W |
| Dioctylphthalate | W |
| Endosulfan | S,W |
| Endrin | S,W |
| Fluoranthene | W |
| Heptachlor | S |
| Heptachlor epoxide | S,W |
| Hexachlorobenzene | B,S |
| Hexachlorobutadiene | B,S,W |
| Lead | S,W |
| Lindane | S,W |
| Mercury | S,W |
| Methoxychlor | B,S |
| Methylene chloride (Dichloromethane) | W |
| Mirex | W |
| Nickel | S,W |
| Pentachlorobiphenyl | S |
| Pentachlorophenol | B,W |
| Phenol | W |

(continued)

Table 5.1 (cont.)

NRTC GROUP I CHEMICALS OF CONCERN* IN THE NIAGARA RIVER

| Group I | Medium of Concern |
|---|---|
| PCB-Aroclor 1242 | B,S |
| PCB-Aroclor 1254 | S |
| PCB-Aroclor 1260 | W |
| Pyrene | W |
| Selenium | W |
| Silver | S,W |
| TCDD | B,W |
| Tetrachlorobiphenyl | S |
| Tetrachloroethene | W |
| Trichlorobiphenyl | S |
| 2,4,5-Trichlorophenol | B |
| 2,4,6-Trichlorophenol | B,S |
| Zinc | S,W |

S = Sediment
W = Ambient Water
B = Biota

*Identified by the Niagara River Toxics Committee based on their potential impact on the environment or human health.

Table 5.2

NRTC GROUP IIA AND IIB CHEMICALS OF CONCERN* IN THE NIAGARA RIVER

| Group II A | Medium of Concern |
|---|---|
| Aniline | S |
| Arsenic | B,W |
| BHC | S |
| BHC-(alpha) | B |
| Bromoform | W |
| Chlordane | B |
| Chlorodibromomethane | S,W |
| Chloroform | S |
| Chloronaphthalene | S,W |
| Chromium | B |
| 2,4-D | W |
| DDD (p,p) | B |
| DDE | B |
| DDT | B |
| 1,2-Dichlorobenzene | S,W |
| 1,3-Dichlorobenzene | S,W |
| 1,4-Dichlorobenzene | B,S,W |
| 1,2-Dichloroethylene | S |
| Dieldrin | B |
| Diphenylamine | S |
| Endosulfan | B |
| Endrin | B |
| Ethylbenzene | S,W |
| Heptachlor | B |
| Heptachlor epoxide | B |
| Hexachlorobenzene | W |
| Lead | B |
| Lindane | B |
| Mirex | B,S |
| Nickel | B |
| Phenol | S |
| Selenium | S |
| Silvex (2,4,5-TP) | W |
| Styrene | W |
| 2,4,5-T | W |
| Tetrachloroethene | S |
| Tribromomethane | S |
| Trichloroethene | W |
| Trichlorophenol | W |
| **Group IIB** | |
| Benzo(b)fluoranthene | S |
| Chrysene | S |
| Dibenz(a,h)anthracene | S,W |
| Dichlorobromomethane | W |
| Dichloronaphthalene | S,W |
| Trichloronaphthalene | S |

S = Sediment
W = Ambient Water
B = Biota

*Identified by the Niagara River Toxics Committee based on their potential impact on the environment or human health.

## Table 5.3

## ORGANIC CHEMICALS FROM TABLES 5.1 AND 5.2 THAT COULD IMPACT ON DRINKING WATER QUALITY

### Group I

Benz(a)anthracene
Benzene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benz(a)pyrene
BHC - (alpha)
Bis(2-ethylhexyl)phthalate
Carbon tetrachloride
Chlordane
Chloroform
Chrysene
DDD (p,p)
DDE
DDT (p,p)
1,2 Dichloroethane
Dieldrin
Dioctylphthalate
Endosulfan
Endrin
Fluoranthene
Heptachlor epoxide
Hexachlorobutadiene
Lindane (=gamma BHC)
Methylene chloride (Dichloromethane)
Mirex
Pentachlorophenol
Phenol
PCB-Aroclor 1260
Pyrene
TCDD
Tetrachloroethene

### Group IIA

Bromoform
Chlorodibromomethane
Chloronaphthalene
2,4-D
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Ethylbenzene
Hexachlorobenzene
Silvex (2,4,5-TP)
Styrene
2,4,5-T
Trichloroethene
Trichlorophenol

### Group II B

Dibenz(a,h)anthracene
Dichlorobromomethane
Dichloronaphthalene

Table 5.4

ORGANIC CHEMICALS FROM TABLE 5.3 WITH DRINKING WATER GUIDELINES

| Chemicals | Guideline Source | Guideline Values (ug/l) | Maximum Level Detected in Treated Water (ug/L) |
|---|---|---|---|
| Benzene | WHO | 10.0 | 1.4 |
| Benz(a)pyrene | WHO | 0.01 | NA |
| Bromoform | MOE/CDN | 350/350 | 0.5 |
| Carbon tetrachloride | WHO | 3.0 | 1.0 |
| Chlordane | MOE/CDN/WHO | 7.0/7.0/0.3 | ND |
| Chlorodibromomethane | MOE/CDN | 350/350 | 10.1 |
| Chloroform | WHO | 30 | 25.2 |
| 2,4-D | MOE/CDN/WHO | 100/100/100 | NA |
| DDD | MOE/CDN | 30/30 | ND |
| DDE | MOE/CDN | 30/30 | ND |
| DDT | MOE/CDN/WHO | 30/30/1.0 | ND |
| 1,2-Dichlorobenzene | WHO | 0.3 | ND |
| 1,4-Dichlorobenzene | WHO | 0.1 | Tr |
| Dichlorobromomethane | MOE/CDN | 350/350 | 18.6 |
| 1,2-Dichloroethane | WHO | 10 | ND |
| Dieldrin | MOE/CDN/WHO | 0.7/0.7/0.03 | ND |
| Endrin | MOE/CDN | 0.2/0.2 | ND |
| Heptachlor epoxide | MOE/CDN/WHO | 3.0/3.0/0.1 | 0.001 |
| Hexachlorobenzene | WHO | 0.01 | ND |
| Lindane | MOE/CDN/WHO | 4.0/4.0/3.0 | 0.001 |
| PCB-Aroclor 1260 | MOE | 3.0 | ND (Total PCB) |
| Pentachlorophenol | WHO | 10 | NA |
| Phenol | MOE/CDN | 2.0/2.0 | NA |
| Silvex (2,4,5-TP) | MOE/CDN | 10/10 | NA |
| Tetrachloroethene | WHO | 10 | 0.1 |
| Trichloroethene | WHO | 30 | 0.1 |

NA = Not Analyzed
ND = Not Detected
Tr = Trace
WHO= World Health Organization
CDN= Canadian Drinking Water Guidelines
MOE= Ontario Drinking Water Guidelines

## Table 5.5

## ORGANIC CHEMICALS FROM TABLE 5.3 WITHOUT DRINKING WATER GUIDELINES

| Chemicals | Maximum Level Detected in Treated Water (ug/L) |
|---|---|
| Benz(a)anthracene | NA |
| Benzo(b)fluoranthene | NA |
| Benzo(k)fluoranthene | NA |
| BHC - (alpha) | 0.014 |
| Bis(2-ethylhexyl)phthalate | NA |
| Chloronaphthalene | NA |
| Chrysene | NA |
| Dibenz(a,h)anthracene | NA |
| 1,3-Dichlorobenzene | ND |
| Dichloronaphthalene | NA |
| Dioctylphthalate | NA |
| Endosulphan | ND |
| Ethylbenzene | 0.2 |
| Fluoranthene | NA |
| Hexachlorobutadiene | NA |
| Methylene chloride (Dichloromethane) | 31.0 |
| Mirex | ND |
| Pyrene | NA |
| Styrene | 0.5 |
| 2,4,5-T | NA |
| TCDD | ND |
| Trichlorophenol | 0.2 |

NA = Not Analyzed

ND = Not Detected

Table 5.6

ORGANIC CHEMICALS FROM TABLE 5.3 NOT MONITORED IN NIAGARA AREA WATER TREATMENT PLANTS

| | | Group |
|---|---|---|
| A. | Chemicals with Guidelines | |
| 1. | Phenol (CDN/MOE) | Hydroxylated Mono Aromatic |
| 2. | Pentachlorophenol (WHO) | Halogenated Phenol |
| 3. | Benz(a)pyrene (WHO) | Polyaromatic Hydrocarbon (PAH) |
| 4. | 2,4-D (CDN/MOE/WHO) | Herbicide |
| 5. | Silvex(2,4,5-TP)(CDN/MOE) | Herbicide |
| B. | Chemicals Without Guidelines | |
| 1. | Benz(a)anthracene | PAH |
| 2. | Benzo(b)fluoranthene | PAH |
| 3. | Benzo(k)fluoranthene | PAH |
| 4. | Dibenz(a,h)anthracene | PAH |
| 5. | Pyrene | PAH |
| 6. | Chrysene | PAH |
| 7. | Fluoranthene | PAH |
| 8. | Chloronaphthalene | Halogenated Diaromatic Hydrocarbon (HDH) |
| 9. | Dichloronaphthalene | HDH |
| 10. | Hexachlorobutadiene | Halogenated Alkene |
| 11. | Dioctylphthalate | Phthalate Ester |
| 12. | Bis(2-ethylhexyl)phthalate | Phthalate Ester |
| 13. | 2,4,5-T | Herbicide |

Table 5.7

ORGANIC CHEMICALS, NOT ON NRTC LISTS, I, IIA, or IIB, THAT WERE DETECTED IN TREATED DRINKING WATER IN THIS STUDY

| Chemical | Maximum Level Detected (ug/L) |
|---|---|
| Acetone | 8.3 |
| Benzaldehyde | 0.1 |
| Butanal | Tr |
| t-Butanol | 0.2 |
| Chlorotoluene | Tr |
| Dibromomethane | 0.2 |
| Dichloroiodomethane | 0.2 |
| Diethyl ether | Tr |
| Dimethyl disulphide | 0.1 |
| Heptanone | 0.3 |
| Hexanal | 0.8 |
| Hexane | 0.3 |
| Isopropanol | 0.7 |
| Methyl ethyl ketone | 0.3 |
| Pentane | 1.1 |
| Tetrahydrofuran | 0.7 |
| Toluene | 1.3 |
| 1,1,4-Trichlorobutadiene | 0.7 |
| 1,1,1-Trichloroethane | 0.1 |
| m - Xylene | 0.5 |
| o- (or p-)Xylene | 0.4 |

Table 5.8

ORGANIC CHEMICALS FROM TABLE 5.7 DEEMED TO BE OF MINIMAL HEALTH CONCERN BY THE IJC*

Acetone
t-Butanol (tert-Butanol)
Diethyl ether
Hexane
Isopropanol (2-Propanol)
Pentane
Toluene
1,1,1-Trichloroethane
m - Xylene
o- (or p-)Xylene

* From Table 7.4 of the 1982 Annual Report of the IJC's Committee on the Assessment of Human Health Effects of Great Lakes Water Quality (see Appendix D).

Table 5.9

ORGANIC CHEMICALS FROM TABLE 5.7
FOR WHICH INSUFFICIENT INFORMATION EXISTS TO MAKE A
HUMAN HEALTH EFFECTS ASSESSMENT

| Chemical | Maximum Level Detected (ug/L) |
|---|---|
| Benzaldehyde | 0.1 |
| Butanal | Tr |
| Chlorotoluene | Tr |
| Dibromomethane | 0.2 |
| Dichloroiodomethane | 0.2 |
| Dimethyl disulphide | 0.1 |
| Heptanone | 0.3 |
| Hexanal | 0.8 |
| Methyl ethyl ketone | 0.3 |
| Tetrahydrofuran | 0.7 |
| 1,1,4-Trichlorobutadiene | 0.7 |

# 6.0 Discussion and Evaluation

## 6.1 Discussion

The NRTC, in its report, listed chemicals from ambient monitoring reports from the eastern end of Lake Erie, the Niagara River and the western end of Lake Ontario, and included those chemicals found in biota, sediment or water. The 261 chemicals in the resultant inventory were divided into three major Groups I, II and III. Those chemicals in Group I were deemed to be of the highest concern because either they were found at levels equal to or exceeding existing criteria or they were considered to pose significant risks to human health or the environment. Group II chemicals were next in importance and were divided into seven subgroups, IIA through IIG. Group IIA and IIB chemicals were considered to represent potential health hazards and surveillance of these was recommended. Group IIC through IIG contain chemicals which the NRTC categorized as requiring further attention. Group III chemicals were considered to pose no immediate health concerns.

The NRTC selection process for developing these chemicals of concern involved the use of six criteria. One of these (USEPA National Interim Drinking Water Standards) involved health risk assessment, but one of a type not commonly used in Canada. The remaining five were all environment-related ambient water criteria which traditionally are lower than drinking water criteria. Since these criteria are different from Canadian drinking water criteria, the chemicals identified in the NRTC Groups I, IIA and IIB may not all be of concern in drinking water from the perspective of human health. It is essential that these chemicals be reassessed to identify those that are of concern from a human health standpoint versus those that are of concern to aquatic organisms.

Of the organic chemicals monitored in the Niagara area drinking water monitoring program, for which drinking water guidelines have been set (Table 5.4), none exceeded the guidelines. Hence, the presence of these chemicals in Niagara area drinking water does not pose an immediate threat to human health. Furthermore, some of those chemicals lacking guidelines, which were detected in the drinking water samples, were previously assessed by the HEC as being of minimal concern from a human health perspective (Table 5.8).

The HEC evaluation of chemicals was carried out based on monitoring and exposure data available up to 1982. Because new data on levels in raw and drinking water are now available, it may be necessary for the HEC to re-evaluate their lists based on more recent information including that used by the NRTC.

For those chemicals listed in Table 5.9, a human health assessment is required in order to determine if continued monitoring and/or the setting of a drinking water guideline is needed.

Dichloroiodomethane was identified in this study as a chemical with insufficient information; however, the WHO has determined that it is not necessary for this compound to have a specific guideline. Consequently, since it is a trihalomethane, consideration should be given to changing the wording of the Canada/Ontario guidelines for total trihalomethanes (350 ug/l) to include this and other minor members of the group.

Chemicals that are usually associated with sediment and/or biota (e.g. the PAH's), would not be expected to appear at significant levels in treated water from plants which use conventional treatment processes. The coagulation/flocculation/filtration stages of such treatment would be expected to remove most chemicals associated with sediment and biota. However, until removals are confirmed, monitoring for these chemicals in drinking water should be carried out. The establishment of guidelines should be considered if these chemicals are subsequently found in treated water.

From Table 5.5, it is apparent that there are five chemicals without guidelines: alpha-BHC, methylene chloride, trichlorophenol, ethyl benzene and styrene. These compounds were detected in the treated drinking water and also appear on the Group I, IIA and IIB lists of the NRTC. Consideration should be given to developing drinking water guidelines for these chemicals.

## 6.2 Analytical Confidence

The purpose of this section is to briefly describe the significance of the analytical values presented in this report. Great care has been taken to avoid contamination of samples. In certain cases, sampling methods for raw water were improved during the course of the study. Internal standards (of surrogate chemicals) were added to the water samples to calculate the loss of chemicals which may occur during the various clean-up steps prior to analysis. Analyses presented by the research laboratories of Health and Welfare Canada have in some cases determined different levels of chemicals from the Ministry of the Environment laboratories which performed the bulk of the analyses. This does not reflect on the quality of analyses from either laboratory but rather shows the variability of data points collected in different data sets.

Finally, in addition to the chemical concentrations presented, there are tables which describe the analytical detection limits which were determined for most of the chemicals of primary concern. As concentrations approach the detection limit, there is a decrease in the analytical confidence in the reported concentrations. Typically, concentrations reported at more than ten times the detection limit have a confidence interval within 10% of the precise concentration. However, this level of confidence decreases considerably for concentrations reported at less than ten times the detection limit, such that values reported at or near the detection limit can have a confidence interval as large as 100% of the actual concentration. It is for this reason that analytical methods strive for the lowest detection limit possible and typically at least an order of magnitude below the level of concern for the chemical. The methods and analyses presented in this report generally have detection limits well below levels of concern for chemicals which have been assessed and for which standards have been developed. Unfortunately, the detection limit for certain chemicals of concern is close to

the level of concern in drinking water. The detection limits presented were accurately determined by the laboratories for the methods used in this report. These were the best analytical techniques available for 1982.

## 6.3 Ongoing Provincial Programs

The Ontario Ministry of the Environment recently updated and published the fourth edition of the "Ontario Drinking Water Objectives" which is the primary document governing the management of drinking water quality in Ontario. The MOE is active in standard setting and is currently focussing attention on the development of drinking water objectives for new contaminants of concern. To develop new standards and objectives for dioxins and furans, an Ontario Scientific Advisory Committee has been constituted. The Ministry supports the need for public participation in standard setting and is investigating the development of a public interest advisory process.

While the Ontario Drinking Water Objectives address a limited number of chemical and trace organic constituents, the Ministry has developed an Interim Priority List of Hazardous Contaminants in Drinking Water, and is employing this list along with the Ontario Drinking Water Objectives in monitoring programs at priority locations.

MOE participates actively on the Federal Provincial Working Group on Drinking Water Quality which has reconvened to consider revisions and additions to the "Guidelines for Canadian Drinking Water Quality - 1978". Working Group deliberations will assist the province in reviewing and updating the Ontario Drinking Water Objectives.

While MOE has been active in carrying out the Routine Inspection of municipal water supply systems which provide potable water to a large majority (85%) of the provincial population, updated policies on Treatment Requirements for water works using surface and ground water sources are under development. These policies will ensure that potable water produced will be in compliance with the Ontario Drinking Water Objectives. Implementing these policies will possibly require the retrofitting of some water works to meet the policy standards.

### 6.3.1 Drinking Water Quality Monitoring

Major public water supplies in Ontario are sampled regularly for a number of physical, chemical and bacteriological substances. As well, knowledge of the quality of water sources and water supplies is developing in relation to chemicals of potential concern in the Ontario ecosystem.

Special contaminant monitoring programs such as the one used as the basis of this report, have focussed selectively on major water supply systems, especially in the industrialized Niagara/Western Lake Ontario area and the St. Clair-Detroit River corridor. These monitoring programs are being continued and intensified.

The Ministry of the Environment has undertaken special surveys for trihalomethanes and asbestos in provincial water supply systems. No problems related to asbestos have been identified. The Ministry continues to actively monitor trihalomethane concentrations and has developed reduction technologies. Widespread application of these technologies has not been required.

The Ministry of the Environment is also participating in a proposed international study by the Canadian Public Health Association to evaluate the status of Great Lakes Water Quality in consideration of their use as a source of drinking water. The study will assemble information on jurisdiction, treatment and monitoring requirements, collect U.S. and Canadian data on levels of chemicals of concern in Great Lakes raw water supplies, evaluate the validity of the data, examine the impact of water treatment technologies, compare the data with existing and proposed drinking water guidelines, and evaluate human health implications.

### 6.3.2 Drinking Water Research & Technical Developments

The Ontario Ministry of the Environment acts as a lead agency in the development of laboratory methods for quantifying trace

organics in drinking water. Recently, a research contract was initiated to develop sensitive analytical methods for the rapid and effective determination of traces of dioxins in water; the results of the research will be essential in establishing environmental and public health standards for dioxins and in developing monitoring programs.

The Ministry has carried out and funded a number of research projects to investigate water disinfection processes including treatment product formation (e.g. trihalomethanes) and control in the chlorination process, and alternative disinfection processes. As well, the Ministry keeps abreast of national and international research on innovative drinking water treatment methods.

A study has been recently completed for the Ministry on the use of ozone as an alternative disinfectant with specific attention to by-products produced and practical application and costs. Ozone is a recognized water treatment chemical but it costs more than chlorine and in recent years its by-products and effectiveness in the distribution systems have been questioned. A current study by a consultant to the Ministry will identify gaps and/or areas of ozone technology which would benefit from further research. There are no Ontario water treatment plants which employ ozonation. It is not considered a cost- or performance-effective alternative at the present time.

Evaluation protocols are being considered to serve as standard test procedures for the province-wide acceptance of water treatment chemicals, coatings, linings and plastic pipes for use in contact with potable water.

### 6.3.3 Ground Water and Private Water Program

The Ontario Ministry of the Environment provides basic private water services through the development of policies and programs on ground water management and home water treatment to serve two million Ontarians and the agriculture industries which rely on ground water.

Ground water protection involves the investigation, assessment and management of point and non-point sources of contamination of groundwater (drinking water) supplies. Activities include determining the effects of nitrates and pesticides on rural aquifers, assessing the impact of acid rain on ground water and plumbing systems, regulating well construction practices to maximize ground water safety, assessing groundwater contamination by highway de-icing salt and determining the impact of landfills on groundwater.

Private water supply services include the development of guidelines and information packages to assist Public Health Units of the Ontario Ministry of Health in their function of ensuring the safety of private water supplies in the Province. The development of revised guidelines for the use of home water treatment devices and the provision of technical advice and public information on alternative potable water sources (e.g. bottled drinking water) are examples of activities within this program.

### 6.3.4 The Drinking Water Surveillance Program

The Drinking Water Surveillance Program (DWSP) is being developed to provide more comprehensive data on drinking water quality in the Province of Ontario. Selected municipal water supplies will be analyzed at least six times (up to a maximum of ten times) during a twelve month period for a comprehensive list of conventional parameters, as well as other possible contaminants. The program is flexible and other parameters will be added as necessary. The monitoring, to be carried out using standard protocols for both sampling and analysis, will provide results for both raw water and treated water at the plants as well as at points in the distribution system. The DWSP will provide reliable and up-to-date water quality information, a definition of contaminant levels and trends, and an indication of plant treatment process efficiency. It will also provide a "flagging" system for violation of Ontario Drinking Water Objectives and a comprehensive basis for determining any necessary remedial action.

### 6.3.5 A Study of Trace Organic Contaminant Removal from Drinking Water

A pilot plant study, using the water from the Niagara River as a raw water source, is being carried out at the City of Niagara Falls (Ontario) Water Treatment Plant. The study, estimated to be carried out over the next 2 1/2 to 3 years, is guided by a steering committee comprising staff from the Ministry of the Environment, Health and Welfare Canada and internationally recognized experts in trace contaminant removal. The project has the following objectives:

a) to assess the effectiveness of optimized conventional drinking water treatment for the removal of trace organic contaminants;

b) to assess the effectiveness of activated carbon adsorption, when used in the add-on contactor mode, for the removal of trace organic contaminants;

c) to determine process operational parameters.

The study will be carried out during all four seasons of the year. Major components of the study are:

1. A review of existing data and pertinent literature, development of analytical and sampling protocol, an experimental design stage, the physical design and equipment set-up.

2. Investigation of removal of organic substances from raw water by:

    a) Jar testing in the engineering laboratory, involving the application of standard testing procedures on a bench scale, determination of the initial conventional

treatment of choice and maintainence of the process in the pilot plant at an optimum level through variations of raw water quality.

b) Pilot plant testing, where a conventional treatment pilot plant will be used to determine the extent of removal of specific and total organic substances by conventional treatment and by activated carbon adsorption, using at least two types of activated carbon.

## 6.4 Ongoing Federal Programs

The Canadian Federal Government has the responsibility for assessing the degree and implications of transboundary movement of organic and inorganic contaminants in water shared by Canada and the United States.

Health and Welfare Canada (Health Protection Branch) is actively involved in research, monitoring and assessment of chemical and microbiological agents found in the Great Lakes, including the Niagara River. Research involves toxicology and analytical methods development. Past and current research focuses on acute, subchronic and chronic bioassays, mutagenicity, teratogenicity, metabolism studies and the development of more sensitive and accurate methods for the detection and quantification of chemicals in drinking water.

Monitoring activities have involved intergovernmental studies on levels of trace organic chemicals in Ontario drinking water, analyses of human tissue samples from major urban centers in the Great Lakes basin, and analyses of commercial fish from the Great Lakes. In addition, 3 national surveys of drinking water and a survey of Great Lakes raw water for trace metals have been completed and several others are planned.

Assessment activities have centered on the threat to human health of contaminants, both organic and inorganic, found in fish, water, sediment, and air. Health and Welfare Canada assesses recreational water quality, drinking water guidelines, and the implications for health of exposure to low levels of many chemicals identified in the Great Lakes. A federal/provincial working group on the abatement of chemical contaminants in drinking water is sponsoring a critical review of treatment and quality of Great Lakes drinking water under a contract with the Canadian Centre for Toxicology.

Co-ordination of Health and Welfare Canada's activities on Great Lakes issues is accomplished at three levels. Internationally, staff work on a variety of committees set up by both the Water Quality Board and the Science Advisory Board of the Canada/U.S. International Joint Commission on the Great Lakes. Health and Welfare staff are actively involved in the HEC and are currently assembling and reviewing the toxicological data available on more than one hundred chemicals in the Great Lakes basin. At the federal level, Health and Welfare Canada co-ordinates its programs with Environment Canada and Department of Fisheries and Oceans through an annual Great Lakes Water Quality Program Plan. The plan covers research, monitoring and assessment activities approved by this interdepartmental committee. Co-ordination with the Province of Ontario is via the Canada-Ontario Agreement Board of Review. An annual report and statement of work plans outlines the joint efforts of these two levels of government.

# APPENDIX A

TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT

REPORTING ON: PESTICIDES STATION: NPBPEST FROM 820101 TO 921231

PESTICIDE COMPOUND LIST

CONCENTRATIONS IN NANOGRAMS/LITRE (NG/L)

| COMPOUND | CODENAME | DETECTION LIMIT |
|---|---|---|
| ALDRIN | ALDR | 1.0 |
| A-BHC | BHCA | 1.0 |
| B-BHC | BHCB | 1.0 |
| G-BHC | BHCG | 1.0 |
| A-CHLORDANE | CHLA | 2.0 |
| G-CHLORDANE | CHLG | 2.0 |
| DIELDRIN | DIEL | 2.0 |
| DMDT-METHOXYCHLOR | DMDT | 5.0 |
| ENDOSULPHAN I | END1 | 2.0 |
| ENDOSULPHAN II | END2 | 4.0 |
| ENDRIN | ENDR | 4.0 |
| ENDOSULPHAN SULPHATE | ENDS | 4.0 |
| HEPTACHLOR EPOXIDE | HEPE | 1.0 |
| HEPTACHLOR | HEPT | 1.0 |
| MIREX | MIRX | 5.0 |
| OXYCHLORDANE | OCHL | 2.0 |
| O,P-DDT | OPDT | 5.0 |
| TOTAL PCB | PCBT | 20.0 |
| P,P-DDD | PPDD | 5.0 |
| P,P-DDE | PPDE | 1.0 |
| P,P-DDT | PPDT | 5.0 |
| HEXACHLOROBENZENE | HCB | 1.0 |
| TETRACHLORODIOXINS(TOTAL) | TECD | 1.0 |

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TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT
REPORTING ON: PESTICIDES STATION: NFRPEST FROM 820101 TO 821231

| DATE TESTED (YYMMDD) | CONSTITUENTS CONCENTRATIONS NANOGRAMS/LITRE (NG/L) | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ALDR | BHCA | BHCB | BHCG | CHLA | CHLG | DIEL | DMDT | END1 | END2 | ENDR | ENDS | HEPE | HEPT | MIRX | OCHL | OPDT | PCBT | PPDD | PPDE | PPDT | HCB | TECD |
| 820107 | <1 | <1 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820202 | <1 | <1 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820315 | <1 | 6 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820405 | <1 | 5 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820421 | <1 | <1 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820506 | <1 | 4 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | 25 | <5 | <1 | <5 | <1 | <1 |
| 820516 | <1 | 7 | <1 | 1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820603 | <1 | 5 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820615 | <1 | 3 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820707 | <1 | 5 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820720 | <1 | 6 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820810 | <1 | 9 | <1 | 7 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820825 | <1 | 5 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 821005 | <1 | 4 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 821021 | <1 | 5 | <1 | 3 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 821103 | <1 | 3 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 821116 | <1 | 5 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 821207 | <1 | 4 | <1 | 2 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 821220 | <1 | 5 | <1 | 2 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |

*** END OF REPORT ***

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TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT
REPORTING ON: PESTICIDES STATION: NFTPEST FROM 820101 TO 821231

| DATE TESTED (YYMMDD) | CONSTITUENTS CONCENTRATIONS NANOGRAMS/LITRE (NG/L) | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ALDR | BHCA | BHCB | BHCG | CHLA | CHLG | DIEL | DNDT | END1 | END2 | ENDR | ENDS | HEPE | HEPT | HIRX | OCHL | OPDT | PCBT | PPDD | PPDE | PPDT | HCB | TECD |
| 820107 | <1 | 8 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820202 | <1 | 5 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820315 | <1 | 6 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820405 | <1 | 6 | <1 | 1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | 1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820421 | <1 | <1 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820506 | <1 | 9 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820518 | <1 | 4 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820603 | <1 | 8 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820615 | <1 | 6 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820707 | <1 | 5 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820720 | <1 | 7 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820810 | <1 | <1 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820825 | <1 | 3 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820908 | <1 | 2 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 821005 | <1 | 4 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 821021 | <1 | 6 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 821102 | <1 | 5 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 821116 | <1 | 4 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 821207 | <1 | 2 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 821220 | <1 | 4 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |

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DATE: NOVEMBER 22 1984

MINISTRY OF THE ENVIRONMENT



TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT

REPORTING ON: PESTICIDES STATION: PERPEST FROM 820101 TO 821231

CONSTITUENTS CONCENTRATIONS NANOGRAMS/LITRE (NG/L)

| DATE TESTED (YYMMDD) | ALDR | BHCA | BHCB | BHCG | CHLA | CHLG | DIEL | DMDT | END1 | END2 | ENDR | ENDS | HEPE | HEPT | MIRX | OCHL | OPDT | PCBT | PPJD | PPDE | PPDT | HCB | TECD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 820107 | <1 | 4 | <1 | 2 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820202 | <1 | 5 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820315 | <1 | 6 | <1 | 1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820421 | <1 | <1 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820518 | <1 | 4 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820615 | <1 | 3 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820720 | <1 | 5 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820825 | <1 | 5 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820921 | <1 | <1 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 821021 | <1 | 5 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 821116 | <1 | 5 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 821220 | <1 | 4 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |

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TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT
REPORTING ON: PESTICIDES STATION: FETPEST FROM 820101 TO 821231

| DATE TESTED (YYMMDD) | CONSTITUENTS CONCENTRATIONS NANOGRAMS/LITRE (NG/L) | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ALDR | BHCA | BHCB | BHCG | CHLA | CHLG | DIEL | DMDT | END1 | END2 | ENDR | ENDS | HEPE | HEPT | MIRX | OCHL | OPDT | PCBT | PPDD | PPDE | PPDT | HCB | TECD |
| 820720 | <1 | <1 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820825 | <1 | 4 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |

*** END OF REPORT ***

MINISTRY OF THE ENVIRONMENT



TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT

REPORTING ON: PESTICIDES STATION: NLRPEST FROM 810701 TO 820731

| DATE TESTED (YYMMDD) | CONSTITUENTS CONCENTRATIONS NANOGRAMS/LITRE (NG/L) | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ALDR | BHCA | BHCB | BHCG | CHLA | CHLG | DIEL | DMDT | END1 | END2 | ENDR | ENDS | HEPE | HEPT | MIRX | OCHL | OPDT | PCBT | PPDD | PPDE | PPDT | HCB | TECD |
| 810722 | <1 | 6 | <1 | 1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | 1 | <1 |
| 810901 | <1 | 5 | <1 | 2 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 811015 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | <1 | <1 |
| 811126 | <1 | <1 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820108 | <1 | 7 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | 30 | <5 | <1 | <5 | <1 | <1 |
| 820203 | <1 | 6 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820303 | <1 | 8 | <1 | <1 | 3 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820316 | <1 | 7 | <1 | 1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820405 | <1 | 6 | <1 | 1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820421 | <1 | <1 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820506 | <1 | 7 | <1 | 1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820518 | <1 | 9 | <1 | 3 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820603 | <1 | 7 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <6 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820615 | <1 | 9 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820707 | <1 | 6 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820720 | <1 | 8 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |

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TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT

REPORTING ON: PESTICIDES STATION: NLTPEST FROM 810701 TO 820731

| DATE TESTED (YYMMDD) | CONSTITUENTS CONCENTRATIONS NANOGRAMS/LITRE (NG/L) | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ALDR | BHCA | BHCB | BHCG | CHLA | CHLG | DIEL | DMDT | END1 | END2 | ENDR | ENDS | HEPE | HEPT | MIRX | OCHL | OPDT | PCBT | PPDD | PPDE | PPDT | HCB | TECD |
| 810901 | <1 | 5 | <1 | 1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 811014 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | <1 | <1 |
| 811120 | <1 | <1 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820108 | <1 | 7 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820203 | <1 | 5 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820303 | <1 | 7 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820316 | <1 | 8 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820405 | <1 | 6 | <1 | 1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820421 | <1 | <1 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820506 | <1 | 9 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820518 | <1 | 7 | <1 | 1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | <1 |
| 820603 | <1 | 14 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820615 | <1 | 5 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820707 | <1 | 6 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |
| 820720 | <1 | 8 | <1 | <1 | <2 | <2 | <2 | <5 | <2 | <4 | <4 | <4 | <1 | <1 | <5 | <2 | <5 | <20 | <5 | <1 | <5 | <1 | NA |

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MINISTRY OF THE ENVIRONMENT



TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT
REPORTING ON: PRIORITY POLLUTANTS STATION: NFRPROR FROM 820101 TO 921231

**********

VOLATILE ORGANICS COMPOUND LIST

CONCENTRATIONS IN MICROGRAMS/LITRE (UG/L)

| COMPOUND | CODENAME | DETECTION LIMIT |
|---|---|---|
| METHYLENE CHLORIDE # | MECL | 5.0 |
| 1,1 DICHLOROETHANE | DCE1 | 0.05 |
| CHLOROFORM | CCL3 | 0.05 |
| 1,2 DICHLOROETHANE | DCE2 | 0.05 |
| 1,1,1-TRICHLOROETHANE | TCE | 0.05 |
| CARBON TERACHLORIDE | CCL4 | 0.05 |
| DICHLOROBROMOMETHANE | DCBM | 0.05 |
| 1,2 DICHLOROPROPANE | DCP | 0.05 |
| TRICHLOROETHYLENE | 3CET | 0.05 |
| CHLORODIBROMOMETHANE | CDBM | 0.05 |
| BENZENE | BENE | 0.05 |
| BROMOFORM | CBR3 | 0.05 |
| TETRACHLOROETHYLENE | 4CET | 0.05 |
| TOLUENE | TOL | 0.05 |
| CHLOROBENZENE | CLBZ | 0.05 |
| ETHYL BENZENE | ETBZ | 0.05 |
| M-XYLENE | M-XY | 0.05 |
| O,P-XYLENE | OPXY | 0.05 |
| HEXANE * | HXNE | 0.05 |
| HEXANAL * | HXAL | 0.05 |
| TETRAHYDROFURAN * | THF | 0.05 |
| DICHLORODIOOMETHANE * | DCIM | 0.05 |
| P-CHLOROTRIFLUOROTOLUENE * | CTFT | 0.05 |
| 1,1,4 TRICHLOROBUTADIENE * | TCBD | 0.05 |

NOTE: ND - NOT DETECTED (I.E. < 0.05)
TR - TRACE (I.E 0.05 < MEASUREMENT < 0.1)
NA - NOT ANALYSED
# - METHYLENE CHLORIDE IS USED AS THE EXTRACTION SOLVENT, VALUES BETWEEN 0.05 AND 5.0 UG/L CANNOT BE ATTRIBUTED TO EITHER SAMPLE OR SOLVENT.
* - POSITIVE VALUES FOR THESE COMPOUNDS ARE APPROXIMATE, VALUES LESS THAN 1.0 UG/L SHOULD BE REGARDED AS TRACE QUANTITIES.

DATE: NOVEMBER 22 1984 MINISTRY OF THE ENVIRONMENT PAGE: 1

TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT
REPORTING ON: PRIORITY POLLUTANTS STATION: NFRPROR FROM 820101 TO 821231

DATE TESTED (YYMMDD) — VOLATILE ORGANICS CONCENTRATIONS MICROGRAMS/LITRE (UG/L)

| DATE TESTED (YYMMDD) | MECL | DCE1 | CCL3 | DCE2 | TCE | CCL4 | DCBM | DCP | 3CET | CDBM | BENZ | CBR3 | 4CET | TOL | CLBZ | ETBZ | M-XY | OPXY | MXNE | MXAL | THF | DCIM | CTET | TCBD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 820107 | ND | ND | TR | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | .1 | ND | ND | ND | ND | .3 | ND | ND | ND | ND | ND |
| 820202 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 820315 | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 820405 | ND | ND | .2 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .2 | ND | ND | ND | ND | ND |
| 820421 | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 820506 | ND | ND | .5 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 820518 | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .2 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 820603 | ND | ND | .4 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 820615 | ND | ND | .2 | ND | ND | ND | ND | ND | ND | ND | TR | ND | ND | .2 | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND |
| 820707 | 14.2 | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND |
| 820720 | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | TR | ND | ND | .2 | ND | ND | ND | TR | .3 | ND | ND | ND | ND | ND |
| 820810 | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND |
| 820825 | 44.0 | ND | .3 | ND | .1 | ND | ND | ND | .1 | ND | ND | ND | .1 | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 820908 | 9.3 | ND | 1.3 | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | .2 | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND |
| 820921 | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND |
| 821005 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND |
| 821021 | 18.0 | ND | .4 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 821102 | 29.0 | ND | .3 | ND | .1 | ND | ND | ND | .2 | ND | ND | ND | .2 | .2 | ND | ND | TR | TR | ND | ND | ND | ND | ND | ND |
| 821116 | ND | ND | .8 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | .1 | ND | 1.0 | ND | ND | ND | ND |
| 821208 | ND | ND | .3 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | .2 | ND | ND | ND | ND | ND | ND |
| 821221 | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | TR | ND | 1.1 | ND | ND | ND | ND |

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TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT
REPORTING ON: PRIORITY POLLUTANTS STATION: NFTPROR FROM 820101 TO 821231

VOLATILE ORGANICS CONCENTRATIONS MICROGRAMS/LITRE (UG/L)

| DATE TESTED (YYMMDD) | MECL | DCE1 | CCL3 | DCE2 | TCE | CCL4 | DCBM | DCP | SCET | CDBM | BENZ | CBR3 | 4CET | TOL | CLBZ | ETBZ | M-XY | OPXY | MXNE | MXAL | THF | DCIM | CTET | TCBO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 820107 | ND | ND | 10.5 | ND | ND | ND | 13.1 | ND | ND | 7.7 | TR | .5 | ND | TR | ND | .1 | .3 | .2 | ND | ND | ND | .1 | ND | .3 |
| 820202 | ND | ND | 5.9 | ND | ND | ND | 5.6 | ND | ND | 3.4 | ND | .4 | ND | .1 | ND | .2 | .5 | .4 | ND | ND | ND | TR | ND | .1 |
| 820315 | ND | ND | 5.8 | ND | ND | ND | 9.5 | ND | ND | 4.8 | ND | .3 | ND | TR | ND | TR | .2 | .1 | ND | ND | ND | .1 | ND | .2 |
| 820405 | ND | ND | 4.5 | ND | ND | ND | 3.7 | ND | ND | 2.1 | ND | .3 | ND | ND | ND | ND | .1 | .1 | ND | ND | ND | ND | ND | .1 |
| 820421 | ND | ND | 4.8 | ND | ND | ND | 5.2 | ND | ND | 2.8 | ND | .3 | ND | ND | ND | ND | .1 | .1 | .1 | ND | ND | ND | ND | .1 |
| 820506 | ND | ND | 11.7 | ND | ND | ND | 4.8 | ND | ND | 2.5 | TR | .2 | ND | .1 | ND | TR | .1 | .1 | ND | ND | ND | ND | ND | .1 |
| 820518 | ND | ND | 10.1 | ND | ND | ND | 7.0 | ND | ND | 2.8 | ND | .2 | ND | .1 | ND | TR | .1 | .1 | TR | ND | ND | ND | ND | .2 |
| 820603 | ND | ND | 8.2 | ND | ND | ND | 5.4 | ND | ND | 3.7 | ND | .3 | ND | TR | ND | ND | .1 | .1 | .1 | ND | ND | ND | ND | .3 |
| 820615 | ND | ND | 7.3 | ND | ND | ND | 9.7 | ND | ND | 3.6 | TR | .3 | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 |
| 820707 | 22.0 | ND | 16.2 | ND | ND | .2 | 9.4 | ND | ND | 3.9 | .4 | .3 | TR | .4 | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND |
| 820720 | 15.8 | ND | 13.9 | ND | ND | ND | 7.5 | ND | ND | 3.4 | .4 | .3 | ND | .4 | ND | ND | ND | TR | .2 | ND | ND | ND | ND | ND |
| 820810 | ND | ND | 18.1 | ND | ND | ND | 10.1 | ND | ND | 5.0 | .4 | .4 | ND | .6 | ND | .1 | .3 | .2 | .1 | ND | ND | ND | ND | ND |
| 820825 | ND | ND | 25.2 | ND | ND | ND | 13.3 | ND | ND | 8.2 | .1 | .4 | ND | .6 | ND | ND | ND | ND | .3 | ND | ND | ND | ND | ND |
| 820908 | 31.0 | ND | 15.9 | ND | ND | TR | 8.2 | ND | .1 | 10.1 | 1.0 | .4 | ND | .5 | ND | ND | ND | ND | .2 | ND | ND | ND | ND | ND |
| 820921 | ND | ND | 20.5 | ND | ND | ND | 10.7 | ND | ND | 5.9 | .5 | .4 | ND | .8 | ND | TR | .2 | .1 | .1 | ND | ND | ND | ND | ND |
| 821005 | 8.8 | ND | 19.2 | ND | ND | 1.0 | 7.6 | ND | ND | 4.0 | TR | .3 | ND | .1 | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND |
| 821021 | 13.0 | ND | 17.0 | ND | ND | ND | 10.0 | ND | ND | 5.2 | .3 | .2 | ND | .7 | ND | .1 | .2 | .2 | ND | ND | ND | ND | ND | ND |
| 821102 | 6.4 | ND | 19.2 | ND | ND | ND | 10.0 | ND | ND | 5.2 | 1.4 | .5 | .1 | .2 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 821116 | ND | ND | 15.0 | ND | ND | ND | 10.3 | ND | ND | 3.8 | ND | .4 | ND | 1.3 | ND | ND | ND | .2 | ND | ND | ND | ND | ND | .3 |
| 821208 | ND | ND | 11.0 | ND | ND | ND | 7.0 | ND | ND | 3.6 | ND | .4 | ND | .3 | ND | ND | ND | TR | ND | ND | ND | ND | ND | .2 |
| 821221 | ND | ND | 15.3 | ND | ND | ND | 9.8 | ND | ND | 4.0 | ND | .3 | ND | .1 | ND | ND | ND | .1 | ND | .3 | ND | ND | ND | .3 |

*** END OF REPORT ***

DATE: NOVEMBER 22 1984

MINISTRY OF THE ENVIRONMENT



TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT
REPORTING ON: PRIORITY POLLUTANTS STATION: FERPROR FROM 820101 TO 821231

VOLATILE ORGANICS CONCENTRATIONS MICROGRAMS/LITRE (UG/L)

| DATE TESTED (YYMMDD) | MECL | DCE1 | CCL3 | DCE2 | TCE | CCL4 | DCBM | DCP | 3CET | COBM | BENZ | CBR3 | 4CET | TOL | CLBZ | ETBZ | M-XY | OPXY | MXNE | MXAL | THF | DCIM | CTFT | TCBD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 820107 | ND | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 820202 | ND | ND | .4 | ND | ND | ND | .2 | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 820315 | ND | ND | .2 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 820421 | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 820518 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 820615 | ND | ND | .2 | ND | ND | ND | ND | ND | ND | ND | TR | ND | ND | .2 | ND | ND | ND | ND | TR | ND | ND | ND | ND | ND |
| 820720 | ND | ND | .1 | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | .2 | ND | ND | ND | ND | .2 | ND | ND | ND | ND | ND |
| 820825 | ND | ND | .2 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 820921 | ND | ND | .8 | ND | ND | ND | ND | ND | ND | ND | TR | ND | .1 | .2 | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND |
| 821021 | ND | ND | .4 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 821116 | ND | ND | .2 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 821221 | ND | ND | .2 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | .1 | ND | ND | ND | ND | ND | ND |

*** END OF REPORT ***

TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT
REPORTING ON: PRIORITY POLLUTANTS STATION: FETPROR FROM 820101 TO 821231

| DATE TESTED (YYMMDD) | VOLATILE ORGANICS CONCENTRATIONS MICROGRAMS/LITRE (UG/L) | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MECL | DCE1 | CCL3 | DCE2 | TCE | CCL4 | DCBM | DCP | 3CET | CDBM | BENZ | CBR3 | 4CET | TOL | CL8Z | ETBZ | M-XY | OPXY | MXNE | NAAL | THF | DCIM | CTFT | TCBD |
| 820720 | ND | ND | 17.9 | ND | ND | ND | 6.9 | ND | ND | 3.5 | TR | .3 | .1 | .2 | ND | ND | ND | NJ | TR | ND | ND | ND | ND | NJ |
| 820825 | ND | ND | 15.4 | ND | ND | ND | 8.8 | ND | ND | 4.0 | .3 | .4 | ND | .4 | ND | ND | .1 | .1 | ND | ND | ND | NJ | ND | NJ |

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DATE: NOVEMBER 22 1984

MINISTRY OF THE ENVIRONMENT



TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT

REPORTING ON: PRIORITY POLLUTANTS STATION: NLRPROR FROM 810701 TO 820731

VOLATILE ORGANICS CONCENTRATIONS MICROGRAMS/LITRE (UG/L)

| DATE TESTED (YYMMDD) | MECL | DCE1 | CCL3 | DCE2 | TCE | CCL4 | DCBM | DCP | 3CET | CDBM | BEMZ | CBR3 | 4CET | TOL | CLBZ | ETBZ | M-XY | OPXY | MXNE | NXAL | TNP | DCIM | CTFT | TCBD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 810722 | 1.4 | ND | .3 | ND | ND | ND | .1 | ND | ND | ND | .1 | ND | .1 | .3 | ND | ND | ND | ND | ND | ND | TR | ND | ND | ND |
| 810901 | .1 | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | TR | ND | ND | ND |
| 811015 | ND | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | TR | ND | ND | ND |
| 811126 | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | TR | ND | ND | .5 | ND | ND | ND | ND | ND | ND | TR | ND | ND | ND |
| 820108 | ND | ND | .6 | ND | .3 | .1 | .3 | ND | .2 | .1 | .1 | ND | ND | .1 | ND | ND | ND | ND | .1 | ND | .3 | ND | ND | ND |
| 820203 | ND | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 820303 | 14.3 | ND | .1 | ND | ND | ND | ND | ND | TR | ND | ND | ND | ND | .1 | ND | .1 | .1 | .2 | ND | ND | .1 | ND | ND | ND |
| 820316 | ND | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 820405 | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 820421 | ND | ND | 2.7 | ND | .1 | ND | .3 | ND | TR | .1 | TR | ND | .1 | ND | ND | ND | ND | ND | .2 | ND | ND | ND | ND | ND |
| 820506 | ND | ND | .6 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .6 | ND | ND | ND |
| 820518 | ND | ND | .2 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 820603 | ND | ND | .6 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND |
| 820615 | ND | ND | .1 | ND | ND | ND | ND | ND | TR | ND | .1 | ND | ND | .1 | ND | ND | ND | ND | TR | .3 | .1 | ND | ND | ND |
| 820707 | ND | ND | .1 | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | TR | TR | ND | .1 | ND | ND | ND |
| 820720 | 50.0 | ND | .2 | ND | TR | ND | ND | ND | ND | ND | ND | ND | TR | .2 | ND | ND | ND | ND | .2 | ND | .1 | ND | TR | ND |

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TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT
REPORTING ON: PRIORITY POLLUTANTS STATION: NLTPROR FROM 810701 TO 820731

VOLATILE ORGANICS CONCENTRATIONS MICROGRAMS/LITRE (UG/L)

| DATE TESTED (YYMMDD) | MECL | DCE1 | CCL3 | DCE2 | TCE | CCL4 | DCBM | DCP | 3CET | CDBM | BENZ | CBR3 | 4CET | TOL | CL8Z | ETBZ | M-XY | OPXY | MXNE | MXAL | TMP | DCIM | CTPT | TCBD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 810722 | TR | ND | 8.2 | ND | ND | ND | 9.3 | ND | ND | 3.7 | .2 | .3 | .1 | .3 | ND | ND | ND | ND | ND | ND | .1 | .2 | ND | ND |
| 810901 | TR | ND | 10.9 | ND | ND | ND | 8.4 | ND | ND | 3.3 | TR | .3 | ND | TR | ND | ND | ND | ND | ND | ND | .1 | .1 | ND | ND |
| 811015 | ND | ND | 7.4 | ND | ND | ND | 7.4 | ND | ND | 3.7 | TR | .3 | ND | TR | ND | ND | ND | ND | ND | ND | TR | TR | ND | ND |
| 811126 | ND | ND | 11.7 | ND | ND | ND | 9.8 | ND | ND | 3.2 | TR | .2 | ND | .6 | ND | ND | ND | ND | ND | ND | TR | .1 | ND | .4 |
| 820108 | 21.7 | ND | 11.6 | ND | .1 | ND | 15.3 | ND | .1 | 6.0 | .2 | .1 | ND | .1 | ND | ND | .1 | .1 | ND | ND | .1 | .1 | ND | .3 |
| 820203 | ND | ND | 6.7 | ND | ND | TR | 7.4 | ND | ND | 3.7 | TR | .2 | ND | .1 | ND | ND | TR | ND | ND | ND | ND | ND | ND | .2 |
| 820303 | ND | ND | 11.2 | ND | TR | ND | 16.3 | ND | ND | 5.4 | TR | .2 | ND | .4 | ND | ND | .1 | .1 | ND | ND | .1 | ND | ND | TR |
| 820310 | ND | ND | 10.2 | ND | ND | ND | 18.6 | ND | .1 | 5.8 | .2 | TR | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | .7 |
| 820405 | ND | ND | 4.6 | ND | ND | ND | 7.9 | ND | ND | 2.3 | ND | .1 | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | .2 |
| 820421 | ND | ND | 5.4 | ND | ND | ND | 2.6 | ND | ND | 2.1 | .1 | .1 | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .2 |
| 820510 | ND | ND | 11.1 | ND | ND | TR | 11.7 | ND | .1 | 5.5 | .1 | .1 | ND | TR | ND | ND | ND | ND | .1 | ND | .7 | ND | ND | .4 |
| 820516 | ND | ND | 10.4 | ND | ND | ND | 7.4 | ND | ND | 2.7 | TR | TR | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | .2 |
| 820601 | ND | ND | 6.5 | ND | ND | ND | 5.0 | ND | ND | 3.3 | .1 | .1 | ND | .2 | ND | ND | ND | ND | TR | .5 | ND | ND | ND | .4 |
| 820615 | ND | ND | 6.1 | ND | TR | ND | 9.3 | ND | ND | 3.5 | .1 | .1 | ND | .3 | ND | ND | TR | TR | .1 | ND | TR | ND | ND | .2 |
| 820707 | 23.0 | ND | 19.3 | ND | ND | .3 | 13.2 | ND | TR | 6.1 | .7 | .2 | TR | .7 | ND | .1 | .3 | .2 | .1 | ND | .2 | ND | ND | ND |
| 820720 | 6.5 | ND | 21.1 | ND | ND | ND | 12.3 | ND | ND | 6.1 | .4 | .3 | TR | .6 | ND | .1 | .2 | .1 | .1 | ND | .2 | ND | ND | ND |

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TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT

REPORTING ON: ORGANICS STATION: NFBORGS FROM 820101 TO 821231

**********

ORGANICS COMPOUND LIST

CONCENTRATIONS IN MICROGRAMS/LITRE (UG/L)

| COMPOUND | CODENAME | DETECTION LIMIT |
|---|---|---|
| TRICHLOROPHENOLS TOTAL | TCPT | 0.05 |
| 2,3,5 TRICHLOROPHENOL | 235T | 0.05 |
| 2,4,6 TRICHLOROPHENOL | 246T | 0.05 |
| 2,3,4/5 TRICHLOROPHENOL | TCP2 | 0.05 |
| 2,3,6 TRICHLOROPHENOL | 236T | 0.05 |
| 3,4,6 TRICHLOROPHENOL | 345T | 0.05 |
| CHLOROTOLUENE * | CLTL | 0.05 |
| ACETONE * | ACTN | 0.05 |
| DIMETHYLDISULPHIDE * | DMDS | 0.05 |
| DICHLOROETHYLENE * | 2CET | 0.05 |
| DIETHYL ETHER * | DEER | 0.05 |
| DICHLOROBENZENE * | DCBZ | 0.05 |
| BUTANOL * | BUOL | 0.05 |
| DICHLOROPROPYLENE * | DCPL | 0.05 |
| TRICHLOROTRIFLUOROETHANE * | 3CFE | 0.05 |
| BENZALDEHYDE * | BNAL | 0.05 |
| STYRENE * | STYR | 0.05 |
| CARBON DISULPHIDE * | CS2 | 0.05 |
| METHYL FURAN * | MEF | 0.05 |
| METHYL ETHYL KETONE * | MEK | 0.05 |
| HEPTANONE * | 7ONE | 0.05 |
| HYDROCARBONS * # | H/C | 0.05 |
| AUXILARY5 | AUX5 | 0.05 |
| AUXILARY6 | AUX6 | 0.05 |

NOTE: ND - NOT DETECTED (I.E. < 0.05)
TR - TRACE (I.E. 0.05 < MEASUREMENT < 0.1)
NA - NOT ANALYSED
* - POSITIVE VALUES FOR THESE COMPOUNDS LESS THAN 1 UG/L SHOULD BE CONSIDERED AS TRACE QUANTITIES (SEMI-QUANTITATIVE).
# - HYDROCARBONS MAY INCLUDE MORE THAN ONE COMPOUND, FIGURE LISTED INDICATES APPROXIMATE CONCENTRATION. HYDROCARBONS ARE UNSUBSTITUTED ALKANES AND ALKENES FOR THIS GROUP OF COMPOUNDS TR MAY INDICATE PRESENT BUT NOT QUANTITIFIED RATHER THAN AS INDICATED ABOVE.

DATE: NOVEMBER 22 1984

MINISTRY OF THE ENVIRONMENT



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NIAGARA DRINKING WATER MONITORING REPORT

REPORTING ON: ORGANICS STATION: NFRORGS FROM 820101 TO 821231

ORGANICS CONCENTRATIONS IN MICROGRAMS/LITRE (UG/L)

| DATE TESTED (YYMMDD) | TCPT | 235T | 246T | TCP2 | 236T | 345T | CLTL | ACTN | ONDS | ZCET | DEER | DCBZ | BUOL | DCPL | 3CFE | BNAL | STYR | CS2 | MEF | MEK | ZOVE | M/C | AUX5 | AUX6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 820107 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | NA | NA |
| 820202 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820315 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820405 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820421 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820506 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820518 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820603 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820615 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .5 | NA | NA |
| 820707 | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | TR | ND | ND | NA | NA |
| 820720 | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | .1 | NA | NA |
| 820810 | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .3 | ND | NA | NA |
| 820825 | ND | ND | ND | ND | ND | ND | ND | 7.4 | ND | ND | .8 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1.1 | NA | NA |
| 820908 | ND | ND | ND | ND | ND | ND | ND | 2.0 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820921 | ND | ND | ND | ND | ND | ND | ND | .4 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .2 | ND | NA | NA |
| 821005 | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .2 | .4 | NA | NA |
| 821021 | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 821102 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 821116 | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 821208 | ND | ND | ND | ND | ND | ND | ND | .2 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | .1 | ND | 1.2 | NA | NA |
| 821221 | ND | ND | ND | ND | ND | ND | ND | .5 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1.4 | NA | NA |

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MINISTRY OF THE ENVIRONMENT



TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT

REPORTING ON: ORGANICS STATION: NFTORGS FROM 820101 TO 821231

ORGANICS CONCENTRATIONS IN MICROGRAMS/LITRE (UG/L)

| DATE TESTED (YYMMDD) | TCPT | 235T | 246T | TCP2 | 236T | 345T | CLTL | ACTN | DMOS | 2CET | DEER | DCBZ | BUOL | DCPL | 3CFE | BNAL | STYR | CS2 | MEF | MEK | ZONE | M/C | AUX5 | AUX6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 820107 | NA | .1 | ND | ND | .1 | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | NA | NA |
| 820202 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820315 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820405 | NA | .1 | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820421 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820506 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820518 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820603 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820615 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820707 | ND | ND | ND | ND | ND | ND | ND | .5 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1.3 | NA | NA |
| 820720 | ND | ND | ND | ND | ND | ND | ND | .2 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820810 | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .2 | .4 | NA | NA |
| 820825 | ND | ND | ND | ND | ND | ND | ND | 8.1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820908 | ND | ND | ND | ND | ND | ND | ND | 9.3 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820921 | ND | ND | ND | ND | ND | ND | ND | .3 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .3 | .5 | NA | NA |
| 821005 | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .2 | .4 | NA | NA |
| 821021 | ND | ND | ND | ND | ND | ND | ND | .5 | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | .7 | NA | NA |
| 821102 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 821116 | ND | ND | ND | ND | ND | ND | ND | .2 | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .3 | ND | ND | NA | NA |
| 821204 | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | .2 | ND | ND | ND | ND | ND | ND | .2 | ND | 1.5 | NA | NA |
| 821221 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1.6 | NA | NA |

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MINISTRY OF THE ENVIRONMENT



TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT

REPORTING ON: ORGANICS STATION: FERORGS FROM 820101 TO 821231

| DATE TESTED (YYMMDD) | ORGANICS CONCENTRATIONS IN MICROGRAMS/LITRE (UG/L) | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TCPT | 235T | 246T | TCP2 | 236T | 345T | CLTL | ACTN | DMDS | 2CET | DEER | DCBZ | BUOL | DCPL | 3CFE | BNAL | STYR | CS2 | MEF | MEK | ZONE | M/C | AUX5 | AUX6 |
| 820107 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820203 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820315 | NA | ND | ND | ND | ND | NA | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820421 | NA | ND | ND | ND | ND | NA | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820518 | NA | ND | ND | ND | ND | NA | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820615 | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .5 | NA | NA |
| 820720 | ND | ND | ND | ND | ND | ND | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | TR | ND | ND | NA | NA |
| 820825 | ND | ND | ND | ND | ND | ND | ND | 1.5 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820921 | ND | ND | ND | ND | ND | ND | ND | 1.3 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .4 | NA | NA |
| 821021 | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | NA | NA |
| 821116 | ND | ND | ND | ND | ND | ND | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 821221 | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1.2 | NA | NA |

*** END OF REPORT ***

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TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT
REPORTING ON: ORGANICS STATION: FETORGS FROM 820101 TO 821231

| DATE TESTED (YYMMDD) | ORGANICS CONCENTRATIONS IN MICROGRAMS/LITRE (UG/L) | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TCPT | 235T | 246T | TCP2 | 236T | 345T | CLTL | ACTN | DMDS | 2CET | DEER | DCBZ | BUOL | DCPL | 3CFE | BNAL | STYR | CS2 | MEF | MEK | 7ONE | H/C | AUX5 | AUX6 |
| 820720 | ND | ND | ND | ND | ND | ND | ND | .2 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820825 | ND | ND | ND | ND | ND | ND | ND | .5 | ND | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |

*** END OF REPORT ***

TECHNICAL SUPPORT SECTION

NIAGARA DRINKING WATER MONITORING REPORT

REPORTING ON: ORGANICS STATION: NLRORGS FROM 810701 TO 820731

ORGANICS CONCENTRATIONS IN MICROGRAMS/LITRE (UG/L)

| DATE TESTED (YYMMDD) | TCPT | 235T | 246T | TCP2 | 236T | 345T | CLTL | ACTN | DMDS | 2CET | DEER | DCBZ | BUOL | DCPL | 3CPE | BNAL | STYR | CS2 | MEF | MEK | ZONE | M/C | AUX5 | AUX6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 810720 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA | |
| 810901 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA | |
| 811015 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA | |
| 811126 | NA | .1 | .2 | ND | .1 | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA | |
| 820108 | NA | ND | .1 | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA | |
| 820203 | NA | ND | .1 | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA | |
| 820303 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | TR | NA | NA |
| 820316 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA | |
| 820405 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA | |
| 820421 | NA | .1 | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA | |
| 820506 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA | |
| 820518 | NA | ND | .1 | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA | |
| 820603 | NA | ND | ND | ND | ND | NA | ND | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA | |
| 820615 | ND | ND | ND | ND | ND | ND | ND | .2 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | TR | ND | TR | NA | NA |
| 820707 | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | TR | ND | .6 | NA | NA |
| 820720 | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | TR | ND | ND | NA | NA |

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NIAGARA DRINKING WATER MONITORING REPORT
REPORTING ON: ORGANICS STATION: NLTORGS FROM 810701 TO 820731

ORGANICS CONCENTRATIONS IN MICROGRAMS/LITRE (UG/L)

| DATE TESTED (YYMMDD) | TCPT | 235T | 246T | TCP2 | 236T | 345T | CLTL | ACTN | OMDS | 2CET | DEER | DCBZ | BUDL | DCPL | 3CFE | BNAL | STYR | CS2 | MEF | MEK | 7ONE | H/C | AUX5 | AUX6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 810720 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | TR | ND | ND | ND | ND | ND | NA | NA |
| 810901 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 811015 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 811126 | NA | .1 | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND | TR | NA | NA |
| 820108 | NA | .1 | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | NA | NA |
| 820203 | NA | .1 | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | TR | NA | NA |
| 820303 | NA | ND | .1 | ND | ND | NA | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .1 | NA | NA |
| 820316 | NA | ND | ND | ND | ND | NA | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820405 | NA | ND | ND | ND | ND | NA | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820421 | NA | .1 | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820506 | NA | .1 | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820518 | NA | ND | ND | ND | ND | NA | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820603 | NA | ND | ND | ND | ND | NA | ND | TR | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| 820615 | ND | ND | ND | ND | ND | ND | ND | .1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | .8 | NA | NA |
| 820707 | ND | ND | ND | ND | ND | ND | ND | .5 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1.5 | NA | NA |
| 820720 | ND | ND | ND | ND | ND | ND | ND | .2 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |

*** END OF REPORT ***

# APPENDIX B

APPENDIX B

## NIAGARA AREA DRINKING WATER TREATMENT PLANTS

Three water treatment plants in the Regional Municipality of Niagara have been considered in this study. The plants are located in Niagara-on-the-Lake, Niagara Falls (Ont.) and Fort Erie, all on the Niagara River. The Niagara-on-the-Lake plant was decommissioned in July 1982 and the Town currently is supplied by pipeline from the DeCew Falls plant in St. Catharines. The old Niagara-on-the-Lake plant is still sampled for raw (untreated) water but obviously there is no longer a treated water supply here.

### B.1 Town of Niagara-on-the-Lake Water Treatment Plant Facility

The Town of Niagara-on-the-Lake water treatment plant, located on Collingwood Street, Town of Niagara, next to Lake Ontario at the mouth of the Niagara River, originally began operation in 1916 in a building which had earlier been constructed as a power generating station in 1891. This plant served the town and part of Niagara Township until July 1982, at which time a new watermain supplying treated water from the DeCew Falls plant in St. Catharines was put in service, and the Town of Niagara plant was retired. A population of 3,400 over an approximate area of 6 square kilometres was being served at the time of decommissioning. The DeCew Falls plant uses Lake Erie water from the Welland Ship Canal as its source.

Raw water supply to the Town of Niagara-on-the-Lake plant was taken from the Niagara River.

Rated plant capacity was 0.86 MIGD, with an emergency peak maximum of 1.8 MIGD. Average output of treated water in 1981 was 0.4 MIGD and demand peaked at a rate of 1.4 MIGD.

River water was drawn through two 10 in. diameter cast iron pipes which rested on a simple wooden cradle. The point of draw was located 60 ft. offshore at a depth of 22 ft.

Raw water entered a 6 ft. square by 15 ft. deep intake well from the intake pipes, one of which had a low lift booster pump connected. On infrequent occasion the booster pump was utilized to maintain well level. The well was fitted with a 3/4 in. mesh stationary screen.

Three pumps delivered river water via a common pipe to three pressure filters which were positioned horizontally in parallel, and from there to the system discharge piping. The pumps were centrifugal, electrically driven and rated individually at 0.86, 0.58 and 0.34 MIGD for a total capacity of 1.8 MIGD. The three filters each sized 8 ft. in diameter by 15 ft. long, employed sand and gravel filter media and were rated at 0.86 MIGD total capacity.

Initial chemical treatment took place at the intake well where aluminum sulphate (alum) was added for coagulation at a dosage rate to achieve a concentration of about 1 mg/l. Chlorination took place via injection of chlorine gas in solution at the suction side of the high lift pumps at a nominal dosage of 0.33 mg/l. On very infrequent occasions, powdered activated carbon was added to the intake well for taste and odour control.

The treated water was delivered through 10 and 12 in. diameter feeders to the distribution system which included a 0.208 MIG elevated surge tank.

## B.2 Niagara Falls Water Treatment Plant Facility

The Niagara Falls Water Treatment Plant is located on Mackelm Street at the corner of Mechanic Street in the City of Niagara Falls, approximately 1/8 kilometre north of the Welland River channel and 1/2 kilometre west of the Niagara River. Treated water from this facility serves a population of 155,000 in the City of Niagara Falls (including Bevan Heights) covering an area of approximately 70 square kilometres.

Raw water is drawn from the Welland River channel, the source of which is Niagara River water flowing westerly through the Welland River channel (Chippawa Creek) to the Chippawa Power Canal.

The original plant was installed in 1930, and an expansion in 1954 increased rated capacity to 32 MIGD. Upgrading in the last two years has further increased rated capacity to 40 MIGD, with an emergency maximum peak rate of 44 MIGD.

Average output in 1981 was 11 MIGD, with a maximum usage of 26 MIGD and a peak demand rate of 30 MIGD.

The raw water intake is a 48 in. diameter reinforced concrete pipe. The pipe is supported by cribbing at the point of draw on the shore of the Welland River channel at a water depth of 18 ft. Intake water flows by gravity 570 ft. via the intake pipe, through two manual travelling screens with 3/8 in. mesh openings to the raw water surge well which is 21.5 ft. x 13.5 ft. x 5 ft. in size.

Alum (aluminum sulphate) for coagulation and flocculation is added at the raw water well ahead of the low lift pumps, which provide flash mixing. Dosage is about 17 ml/l of liquid alum. Five low lift pumps deliver the flow through six baffled mixing/flocculation chambers, then to six sedimentation basins. Information on the pumps and sedimentation basins is as follows:

Low Lift Pumps - submersible, vertical turbine

| | | | |
|---|---|---|---|
| One | 6 MIGD | Two | 10 MIGD |
| One | 8 MIGD | One | 12 MIGD |

Sedimentation Basins - Horizontal flow, concrete

| | |
|---|---|
| Three | 25 ft. x 117 ft. x 18 ft. |
| Three | 25 ft. x 133 ft. x 21 ft. |

The settled water is then pre-chlorinated by the addition of chlorine gas in solution ahead of filtration, at a dosage of approximately 0.8 mg/l. Two sections of dual media anthracite coal and sand rapid gravity filters, each with eight individual filters, are nominally rated at 12 and 20 MIGD, although the media have been upgraded since original construction. The filtered water enters two clearwells, one 145 ft. x 62 ft. x 19 ft. and the other 180 ft. x 62 ft. x 13 ft., for a total clearwell surge capacity of 1.75 MIG.

Post-chlorination takes place at the suction to the high lift pumps, at a dosage of about 0.4 mg/l. High lift pump data is as follows:

High Lift Pumps - Four horizontal, centrifugal pumps of which two are rated at 6 MIGD and two at 10 MIGD plus one dual drive electric pump rated at 12 MIGD.

Forcemains up to 42 in. diameter carry treated water to the distribution system which includes an elevated surge tank of 0.54 MIG capacity.

## B.3 Rosehill Water Treatment Plant, Fort Erie Facility

The Rosehill Water Treatment Plant is located at the south end of Rosehill Road in the Town of Fort Erie, approximately five kilometres west of the convergence of Lake Erie and the Niagara River. Treated water from this facility serves a population of 24,000 over an estimated area of 70 square kilometres in Fort Erie, Crystal Beach, Ridgeway, Stevensville and Douglastown.

Expansion and modernization of the Rosehill plant were completed in 1980. This allowed phasing out of the two older plants at Crystal Beach and old Fort Erie. The remodelling increased delivery capacity from 6 MIGD to 10 MIGD, with an emergency maximum rate of 17 MIGD.

Average output in 1981 was 3.4 MIGD, with a maximum usage of 6.8 MIGD and a peak demand rate of 11.0 MIGD.

Lake Erie is the source of raw water for the Rosehill Water Treatment plant.

The intake structure takes the form of an inverted cone connected to the 42 in. diameter intake pipe and supported by a 13 ft. square wooden crib. It is positioned about 1600 ft. offshore between Windmill Point and Bertie Bay where water depth averages approximately 20 ft.

A protective bar screen precedes two 1/4 in. mesh automatic travelling screens ahead of the raw water well. This well, 26 ft. by 16 ft. by 24 ft. deep, supplies four vertical turbine low lift pumps; two are rated at 3 MIGD and two at 5.5 MIGD.

Pre-chlorination using chlorine gas in solution, and alum (aluminum sulphate) addition for coagulation, are carried out between the low lift pumps and flocculation units at approximate dosage rates of 1.1 mg/l and 5.3 ml/l (of liquid alum), respectively. The water then passes through in-line blenders and enters a 16.7 ft. square by 15.7 ft. deep three stage flocculation zone where mixing intensity is less at each stage. Sedimentation then takes place in a basin sized 51 ft. x 34 ft. x 15.7 ft. deep with tube settlers.

Settling is followed by filtration through four open gravity anthracite and sand filters, each rated at 2.5 MIGD. The filtered water next enters the clearwell, where it is post-chlorinated via injection of chlorine gas in solution at an approximate dosage of 0.7 mg/l, then flows to an underground 6 MIG storage reservoir. From there four high lift pumps, capacity rated as shown below, deliver the flow to the town distribution system.

| | | |
|---|---|---|
| High Lift Pumps: | Vertical turbine | |
| | Two | 6 MIGD |
| | One | 3 MIGD |
| | One | 2 MIGD |

Treated water leaves the plant through a 24 in. diameter high pressure concrete feedermain which supplies the distribution system. In recent years, this system has been extended to link areas fed by the original treatment plants more adequately. Included in the system are two elevated surge tanks sized at 0.2 MIG and 0.325 MIG capacities.

During summer months, chlorine dioxide used to be added, as required, for taste and odour control. In 1983, powdered activated carbon, added ahead of mixing and filtration, replaced chlorine dioxide for this purpose.

# APPENDIX C

APPENDIX C

Ambient Water Quality Criteria for Organic Chemicals as set forth by the Environmental Protection Agency (U.S.A.)

| Chemical | Criteria (ug/l) | Chemical | Criteria (ug/l) |
|---|---|---|---|
| Acenaphthene | 20.0* | 2,6-Dichlorophenol | 0.2* |
| Acrolein | 320.0@ | 3,4-Dichlorophenol | 0.3* |
| Acrylonitrile | 0.58* | Dichloropropanes | 87.0@ |
| Aldrin | 0.00074* | Dichloropropenes | 87.0@ |
| Benzene | 6.6* | Dieldrin | 0.00076* |
| Benzidine | 0.0012* | 2,4-Dinitrotoluene | 1.1* |
| Bis-(chloromethyl)-ether | 0.000038* | 1,2-Diphenylhydrazine | 422* |
| Carbon tetrachloride | 4.0* | 2,4-Dinitro-o-cresol | 13.4@ |
| Chlordane | 0.0046* | Dinitrophenol | 70.0@ |
| (2-Chloroethyl) ether | 0.0003* | Endosulfan | 74.0@ |
| (2-Chloroisopropyl)ether | 34.7@ | Ethylbenzene | 1400@ |
| Chloroform | 1.9* | Fluoranthene | 42.0@ |
| 2-Chlorophenol | 0.1* | Halomethanes | 1.9* |
| DDT | 0.00024* | Heptachlor | 0.0027* |
| Dichlorobenzene | 400.0@ | Hexachlorobenzene | 0.0072* |
| Dichlorobenzidine | 0.103* | Hexachlorobutadiene | 4.47* |
| 1,2-Dichloroethane | 9.4 | Hexachloroethane | 19.0* |
| Dichloroethylenes | 0.33* | Lindane: alpha-BHC | 0.00092* |
| 2,3-Dichlorophenol | 0.04* | beta-BHC | 0.00016* |
| 2,4-Dichlorophenol | 0.3 | gamma-BHC | 0.00018* |
| 2,5-Dichlorophenol | 5.0 | delta-BHC | 0.00012* |
| Isophorone | 5200.0 | 1,2,4,5-Tetrachlorobenzene | 38.0@ |
| 2-methyl-4-chlorophenol | 1800* | 1,1,2,2-Tetrachloroethane | 1.7* |
| 3-methyl-4-chlorophenol | 3000* | Tetrachloroethane | 8.0* |
| 3-methyl-6-chlorophenol | 20.0* | Toluene | 14300@ |
| Monochlorobenzene | 20.0* | Toxaphene | 0.007* |
| Monochlorophenol | 0.1* | 1,1,1-Trichloroethane | 18.4@ |
| n'-Nitrosodimethylamine | 0.014* | Trichloroethylene | 27.0* |

APPENDIX C (Con't)

Ambient Water Quality Criteria for Organic Chemicals as set forth by the Environmental Protection Agency (U.S.A.)

| Chemical | Criteria (ug/l) | Chemical | Criteria (ug/l) |
|---|---|---|---|
| n-Nitrosodiethylamine | 0.008* | Vinyl Chloride | 20.0* |
| n-Nitrosodi-n-butylamine | 0.064* | | |
| n-Nitrosodiphenylamine | 49.0* | Phthalate Esters: | |
| n-Nitrosopyrrolidine | 0.16* | dimethylphthalate | 3130000 |
| Pentachlorobenzene | 74.0@ | diethylphthalate | 3500000 |
| Pentachlorophenol | 1.01@ | dibutylphthalate | 340000 |
| Phenol | 3500.0@ | di-2-ethylhexyl-phthalate | 15000@ |
| | | PCBs | 0.00079* |
| | | Polynuclear aromatic hydrocarbons (PAH's) | 0.00028* |

Values are derived from virtually safe dose (*), Acceptable Daily Intake (@) or organoleptic properties (**)

# APPENDIX D

TABLE 7.4
CHEMICALS FOUND IN THE GREAT LAKES OF MINIMAL CURRENT CONCERN FROM A HUMAN HEALTH PERSPECTIVE*

| CHEMICAL NAME | CAS NO. |
|---|---|
| **PESTICIDES** | |
| Atrazine | 1912-24-9 |
| Carbofuran | 1563-66-0 |
| Dicamba | 1918-00-9 |
| Ethion | 563-12-2 |
| Leptophos | 21609-90-5 |
| Malathion | 121-75-5 |
| MCPA (4-chloro-o-toloxy acetic acid) | 94-74-6 |
| **ALIPHATIC HYDROCARBONS** | |
| Butane | 106-97-8 |
| Butene (1-) | 106-98-9 |
| (2-) | 107-01-7 |
| 1,3-Butadiene | 106-99-0 |
| 1-Buten-3-yne | 689-97-4 |
| Pentane | 109-66-0 |
| Neopentane | 463-82-1 |
| Cyclopentane | 287-92-3 |
| Pentene (1-) | 109-67-1 |
| (2-) | 109-68-2 |
| Hexane | 110-54-3 |
| Cyclohexane | 110-82-7 |
| Heptane | 25339-56-4 |
| Hexene | 25264-93-1 |
| Nonene | 27215-95-8 |
| 2,5-Dimethyldecane | 17312-50-4 |
| 2,6-Dimethylundecane | 17301-23-4 |
| Tetradecane | 629-59-4 |
| Tetradecene | 1120-36-1 |
| Hexadecane | 544-76-3 |
| Decylcyclohexane | 1795-16-0 |
| Heptadecane | 629-78-7 |
| 10-Methyleicosane | 55193-54-1 |
| Tetracosane | 646-31-1 |
| **HALOGENATED HYDROCARBONS** | |
| Dichloromethane | 75-09-2 |
| Dichlorodifluoromethane | 75-71-8 |
| Trichlorofluoromethane | 75-69-4 |
| Dichlorobromofluoromethane | 353-58-2 |
| 1,1,1-Trichloroethane | 71-55-6 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 76-13-1 |
| **AROMATIC HYDROCARBONS** | |
| Benzene | 71-43-2 |
| Toluene | 108-88-3 |
| Xylene (o-) | 95-47-6 |
| (m-) | 108-38-3 |
| (p-) | 106-42-3 |
| Propylbenzene | 103-65-1 |
| Cumene | 98-82-8 |
| Propyltoluene | 28729-54-6 |
| Diethylbenzene | 25340-17-4 |
| Naphthalene | 91-20-3 |
| 1,2-Dihydro-4-methylnaphthalene | 2717-47-7 |
| Diphenyl | 92-52-4 |
| Dimethylbiphenyl | 28804-11-8 |
| Acenaphthene | 83-32-9 |
| Diphenylmethane | 101-81-5 |
| Fluorene | 86-73-7 |
| Anthracene | 120-12-7 |
| Methylanthracene (1-) | 610-48-0 |
| (2-) | 613-12-7 |
| (9-) | 779-02-2 |
| Phenanthrene | 85-01-8 |
| Methylphenanthrene | 28652-81-5 |
| Fluoranthene | 206-44-0 |
| Pyrene | 129-00-0 |
| Benzofluorene (1,2-) | 238-84-6 |
| (2,3-) | 243-17-4 |
| Benzanthrene | 56-55-3 |
| Benzo(k)fluoranthene | 207-08-9 |
| Perylene | 198-55-0 |
| Coronene | 191-07-1 |
| Dibenzo(def,mno)chrysene | 191-26-4 |
| **ALCOHOLS** | |
| Propanol (1-) | 71-23-8 |
| (2-) | 67-63-0 |
| tert-Butanol | 75-65-0 |
| 2-Buten-1-ol | 6117-91-5 |
| 2-Ethyl-1-hexanol | 104-76-7 |
| 1-Decanol | 112-30-1 |
| Tetradecanol | 27196-00-5 |
| 1-Octadecanol | 112-92-5 |
| 1-Dodecanol | 112-53-8 |
| Benzyl alcohol | 100-51-6 |

| CHEMICAL NAME | CAS NO. |
|---|---|
| **ALDEHYDES** | |
| Formaldehyde | 50-00-0 |
| Vanillin | 121-33-5 |
| **KETONES** | |
| Acetone | 67-64-1 |
| 2-Butanone | 78-93-3 |
| 3-Pentanone | 96-22-0 |
| Acetophenone | 98-86-2 |
| 4-Methyl-2-pentanone | 108-10-1 |
| **ETHERS** | |
| Diethyl ether | 60-29-7 |
| Diisopropyl ether | 108-20-3 |
| Safrole | 94-59-7 |
| **ACIDS AND ESTERS** | |
| Methacrylic acid, methyl ester | 80-62-6 |
| 2-Methylpentanoic acid | 97-61-0 |
| Hexanoic acid (Caproic acid) | 142-62-1 |
| Hexanedioic acid, dimethyl ester (Dimethyl adipate) | 627-93-0 |
| Hexanedioic acid, dihexyl ester (Dihexyl adipate) | 110-33-8 |
| Heptanoic acid (Enanthic acid) | 111-14-8 |
| Octanoic acid (Caprylic acid) | 124-07-2 |
| 2-Ethylhexanoic acid, methyl ester | 816-19-3 |
| Nonanoic acid (Pelargonic acid) | 112-05-0 |
| Decanoic acid (Capric acid) | 334-48-5 |
| Dodecanoic acid (Lauric acid) | 143-07-7 |
| Dodecanoic acid, methyl ester (Methyl laurate) | 111-82-0 |
| Tetradecanoic acid (Myristic acid) | 544-63-8 |
| Tetradecanoic acid, methyl ester (Methyl myristate) | 124-10-7 |
| Pentadecanoic acid | 1002-84-2 |
| Hexadecanoic acid, methyl ester (Methyl palmitate) | 112-39-0 |
| Hexadecanoic acid, ethyl ester (Ethyl palmitate) | 628-97-7 |
| Hexadecanoic acid (Palmitic acid) | 57-10-3 |
| 9-Hexadecanoic acid (Palmitoleic acid) | 2091-29-4 |
| Heptadecanoic acid (Margaric acid) | 506-12-7 |
| Octadecanoic acid, methyl ester (Methyl stearate) | 112-61-8 |
| 9,10-Dihydroxyoctadecanoic acid, methyl ester | 1115-01-1 |
| 9-Octadecenoic acid (cis)(Oleic acid) | 112-80-1 |
| 9-Octadecenoic acid, methyl ester (trans) (Methyl elaidate) | 1937-62-8 |
| 9,12-Octadecadienoic acid (Linoleic acid) | 60-33-3 |
| 9,12,15-Octadecatrienoic acid, methyl ester (Methyl linolenate) | 301-00-8 |
| 2-Methyloctadecanoic acid | 7217-83-6 |
| Eicosanoic acid (Arachidic acid) | 506-30-9 |
| Eicosanoic acid, methyl ester (Methyl arachidate) | 1120-28-1 |
| Docosanoic acid (Behenic acid) | 112-85-6 |
| Tetracosanoic acid (Lignoceric acid) | 557-59-5 |
| Benzoic acid | 65-85-0 |
| Salicylic acid | 69-72-7 |
| Phthalic acid, dibutyl ester | 84-74-2 |
| Phthalic acid, butyl ester, ester with butylglycolate | 85-70-1 |
| **PHENOLS** | |
| Guaiacol (methoxyphenol) | 90-05-1 |
| Phenol | 108-95-2 |
| **TERPENES** | |
| Borneol | 507-70-0 |
| Camphene | 79-92-5 |
| Camphor | 464-49-3 |
| Isoborneol | 124-76-5 |
| Limonene | 138-86-3 |
| Pinene (a-) | 80-56-8 |
| (b-) | 127-91-3 |
| Terpineol | 8000-41-7 |
| **MISCELLANEOUS** | |
| Benzothiazole | 95-16-9 |
| Caffeine | 58-08-2 |
| Carbon disulfide | 75-15-0 |
| N,N-Dimethylaniline | 121-69-7 |
| **ELEMENTS** | |
| Cobalt | 7440-48-4 |
| Copper | 7440-50-8 |
| Strontium | 7440-24-6 |
| Vanadium | 7440-62-2 |
| Zinc | 7440-66-6 |

* Based on all available data on toxicity, use and environmental levels.

# APPENDIX E

# Purge and Trap
# Analysis for Volatile Organics

## Standards

### Stock Solutions (approx. 20 ug/ul)

These are made at exact concentrations of about 2 ug/ul in methanol.

### Working Solutions

A 1:10 dilution of the stock gives 200 ng/ul in methanol.

The following are included in the standard mix:

| | |
|---|---|
| Benzene | 1,2-Dichloroethane |
| Toluene | 1,2-Dichloropropane |
| Ethyl Benzene | Chlorobenzene |
| m-xylene | 1,1-Dichloroethane |
| o-xylene | 1,1,1-Trichloroethane |
| p-xylene | Chloro Dibromomethane |
| Methylene Chloride | Bromo Dichloromethane |
| Chloroform | Trichloroethylene |
| Tetra Chloro Ethylene | Carbon Tetrachloride |
| Bromoform | |

Mixed working solutions can also be prepared by the same method.

## Internal Standard Solution

Add 10 ul of the stock solution (20 ug/ul) to 10 ml prepurged water, giving a concentration of 20 mg/L. Use this working solution to spike each test and standard run to a concentration of 200 ng/L, ie. 10 ul in 1 L sample.

Apparatus

1 Liter purge bottle

- Inlet for dry nitrogen to pass through glass sinter at base of bottle

- Glass connection at top of bottle to attach tenax trap (see diag.)

- Desorption unit for GC (see diag.)

Materials

Organic-free water for standards: Prepared by purging millipore water for 30 minutes with no tenax trap in position.

Nitrogen: pre-purified

Trap packing: Tenax GC 60/80 mesh.

Procedure for Water Samples

Remove samples from cold storage approximately one hour prior to analysis and bring to room temperature. The purge bottle is heated with millipore water for at least one hour prior to use with a sample.

Heat water in a 4 L beaker to 80-90°C to act as a heating jacket. Place sample into 1 L purge bottle, add 10 ul internal standard solution. Attach tenax trap to top of purge bottle. Adjust nitrogen purge to 26 ml/min (flow meter setting of 80) and connect nitrogen line. Purge sample for 30 minutes. In the meantime, the GC should be cycled from 35°C to 170°C at 8°/min and cooled back to Room Temperature. Insert trap into desorber, with the end of the trap which was closest to purged sample being inserted closest to the GC column, and connect helium. Heat the desorber from RT to 200°C (approx. setting 64%). Start temperature program when commencing desorption. Begin collecting MS data 8 minutes from the start.

Purge Parameters

Purge gas: Nitrogen, high purity grade
Purge time: 30 min.
Purge temperature: 85°C
Purge flow: 26 ml/min (setting 80)
Trap sorbent: Tenax GC, 60/80 mesh
Desorption temp: 200°C

Gas Chromatographic Parameters

Precolumn: 2½" x 1/8" Nickel - Tenax GC 60/80 mesh

Column - 12' x 1/8" o.d. nickel 0.2% Carbowax 20M on Carbopack C 60/80 mesh

Carrier - Helium (via desorption unit) at 30 ml/min

Oven Temperature: a) 30°C for 6 min (oven open)
b) 30°-170° @ 8°/m and hold

Injector temperature: 200°C

Detector temperature: 225°C

Range: $10^{-11}$ (or as previously determined)

GC/MS Interface Temperature: 200°C

Mass Spectrometer Parameters

Instrument: Dupont 21-491B
Data System: DS50S
Separator: Glass Jet
Electron energy: 70 ev
Emission current setting: High
Coarse mass setting: 510
Approximate useable mass range: 305-28 a.m.u.
Scanning rate: 2 sec/decade

## Quality Assurance

Sample blanks: Prepared by purging millipore water into a tenax trap in the manner described and analysis of the contents of the trap by GC/MS.

Standard solutions: 1 L prepurged millipore water is spiked with the aromatic and halogenated hydrocarbons standards to a level of 1 ppb and 10 ppb respectively. The spiked standard is then purged and analysed in the manner described for samples.

A standard solution should be analysed each day on which samples are analysed. Recovery is calculated by comparing the results of purging with the results of injecting working standard solutions onto the trap, and desorbing in the normal way after first evaporating the methanol in a gentle stream of helium.

Sample blanks should be analysed after every ten sample analyses to ensure that the trap is being regenerated between runs.

## Quantitation

### Internal Standard

#### FID Response

$$\text{Calculate: } \frac{\text{Pk Ht Component}}{\text{Pk Ht Int Std}} \times \frac{\text{Attenuation component}}{\text{Attenuation Int Std}}$$

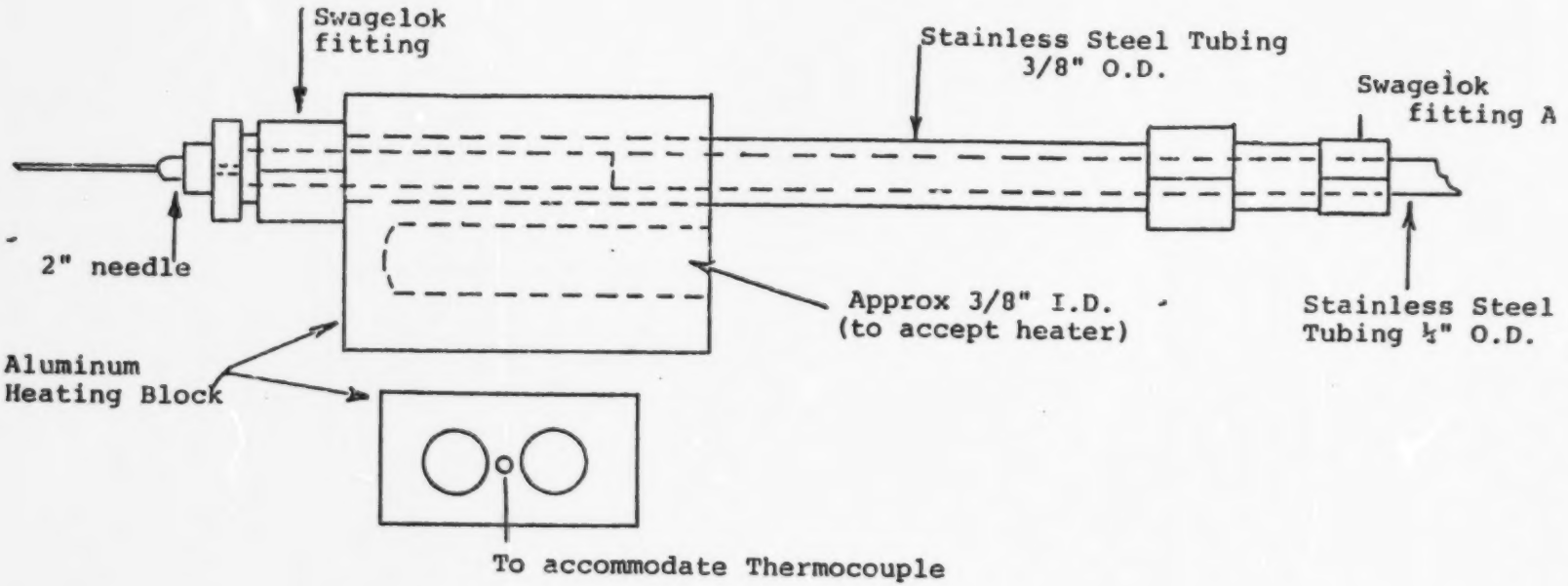
Read concentration from standard curve.

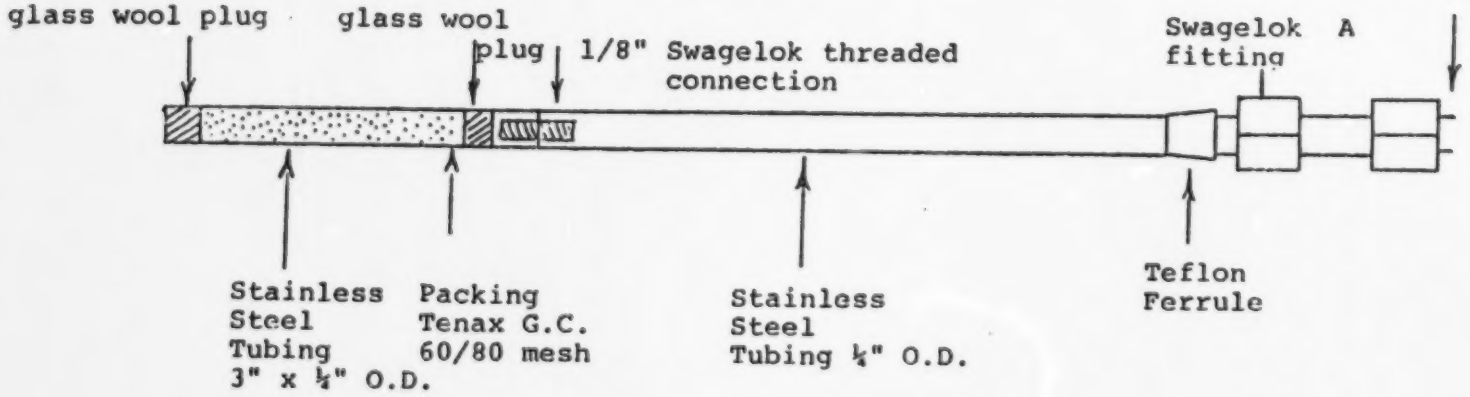
### MS Response

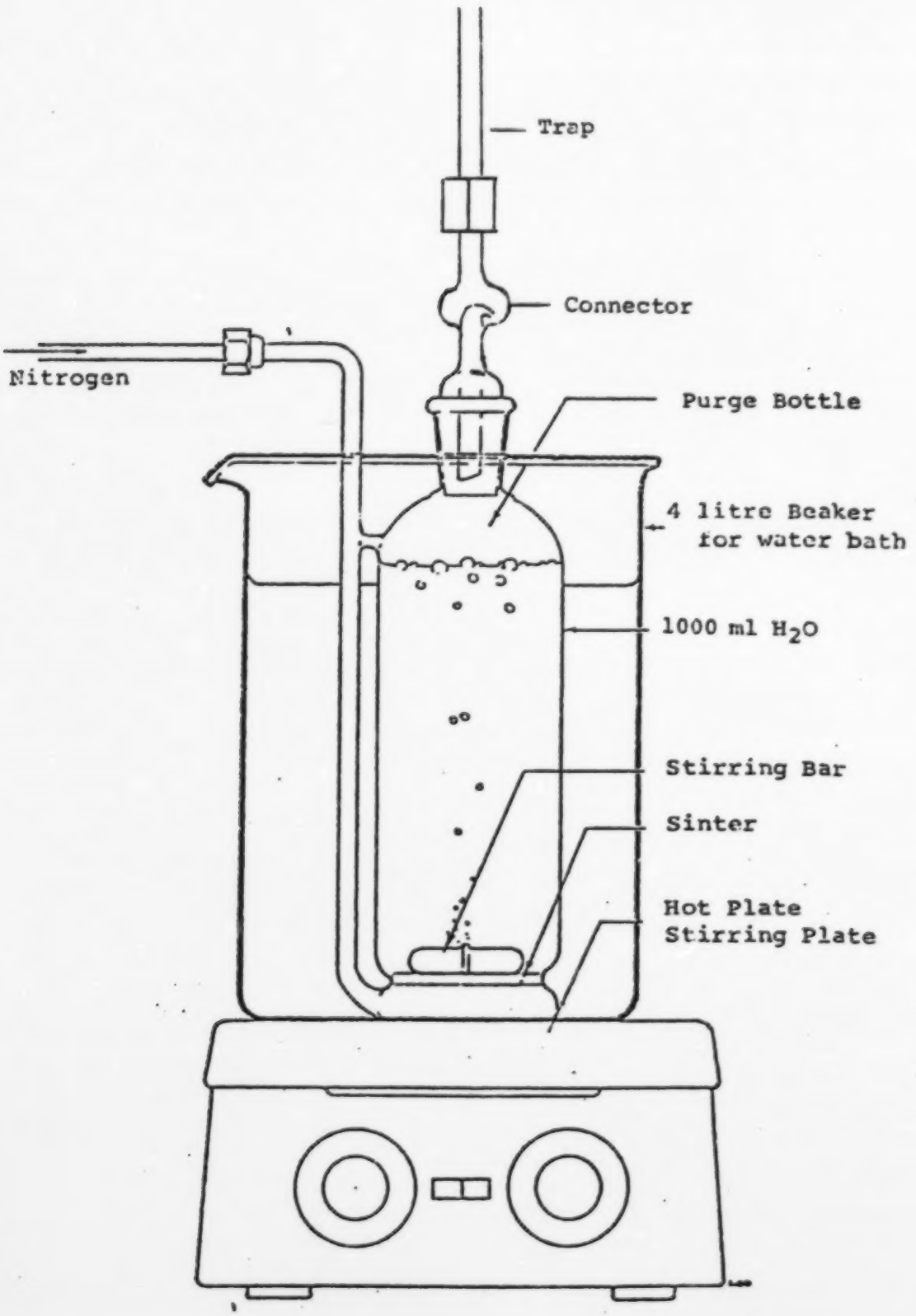
$$\text{Concentration: } \frac{\text{Ion Intensity for Component}^{*}}{\text{Ion Intensity of m/e 90 for I.S.}} \times \text{Factor}^{+}$$

* For each component an appropriate ion is used for quantitation.

\+ Factor is determined for known concentrations of each component.


Swagelok fitting
Stainless Steel Tubing 3/8" O.D.
Swagelok fitting A
2" needle
Approx 3/8" I.D. (to accept heater)
Stainless Steel Tubing ¼" O.D.
Aluminum Heating Block
To accommodate Thermocouple


glass wool plug
glass wool plug
1/8" Swagelok threaded connection
Swagelok A fitting
Stainless Steel Tubing 3" x ¼" O.D.
Packing Tenax G.C. 60/80 mesh
Stainless Steel Tubing ¼" O.D.
Teflon Ferrule


Trap
Connector
Nitrogen
Purge Bottle
4 litre Beaker
for water bath
1000 ml $H_2O$
Stirring Bar
Sinter
Hot Plate
Stirring Plate

# APPENDIX F

APPENDIX F

Table F1

TYPICAL VOLATILE ORGANICS DETECTABLE BY MOE USING GC/MS PURGE AND TRAP METHOD

Acetone
Acrylonitrile
Benzaldehyde
Benzene
Bromochlorobenzene
Bromoform
Butanal
n-Butanol
s-Butanol (Butan-2-ol)
t-Butanol
Carbon disulphide
Carbon tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane
Chloroethylene
Chloroethyl ether
Chloroform
Chlorotoluene
p-Chlorotrifluorotoluene
Cumene (Isopropyl benzene)
Cyclohexanone
Dibromomethane
Dibutyl ether
1,2-Dichlorobenzene
Dichlorobromomethane
1,1-Dichloroethane
1,2-Dichloroethane
trans-1,2-Dichloroethylene
Dichloroiodomethane
Dichloromethane (Methylene chloride)
1,2-Dichloropropane
Dichloropropylene
Diethyl benzene
Diethyl disulphide
Diethyl ether
Dimethyl disulphide
Dimethyl sulphide
Divinyl benzene
Ethanol
Ethyl benzene
Ethyl toluene
Heptanal
Heptane ($C_7H_{16}$)
Heptanone
Heptene ($C_7H_{14}$)
Hexanal
Hexane ($C_6H_{14}$)
Hexanone
Hexene ($C_6H_{12}$)
Hexenone
Hydrocarbons
Isobutanal
Isobutanol
Isopropanol (Isopropyl alcohol)
Methyl ethyl ketone
Methyl furan
Methyl pentene
2-Methyl pyrrole
Pentane ($C_5H_{12}$)
Pentene ($C_5H_{10}$)
2-Pentyl furan
Propyl benzene
Propylene sulphide
Styrene
1,1,2,2-Tetrachloroethane
Tetrachloroethene
Tetrachloropropane
Tetrahydrofuran
Toluene
1,1,4-Trichlorobutadiene
1,1,1-Trichloroethane
Trichloroethene
Trichlorotrifluoroethane
Triethyl benzene
Trimethyl benzene
m-Xylene
o/p-Xylene

Detection Limit is 0.1 ug/l for Volatile Organics Except Dichloromethane (5.0 ug/l)

APPENDIX F

Table F2

ORGANO-CHLORINE PESTICIDES DETECTABLE BY MOE USING GAS CHROMATOGRAPHY/ELECTRON CAPTURE DETECTION METHOD

| Compound | Detection Limit in ug/L |
|---|---|
| Aldrin | 0.001 |
| Alpha-BHC | 0.001 |
| Beta-BHC | 0.001 |
| Gamma-BHC (Lindane) | 0.001 |
| Alpha-Chlordane | 0.002 |
| Gamma-Chlordane | 0.002 |
| Dieldrin | 0.002 |
| Methoxychlor (DMDT) | 0.005 |
| Endosulfan I (Thiodan I) | 0.002 |
| Endosulfan II (Thiodan II) | 0.004 |
| Endrin | 0.004 |
| Endosulfan sulphate | 0.004 |
| Heptachlor epoxide | 0.001 |
| Heptachlor | 0.001 |
| Mirex | 0.005 |
| Oxychlordane | 0.002 |
| DDT (o,p') | 0.005 |
| PCB (total) | 0.020 |
| DDD (p,p') | 0.005 |
| DDE (p,p') | 0.001 |
| DDT (p,p') | 0.005 |

APPENDIX F

Table F3

SPECIFIC ANALYSES

| Compound | Detection Limit in ug/L |
|---|---|
| Tetrachlorodioxins (total) | 0.000010 |
| Hexachlorobenzene | 0.001 |
| 2,4,6 Trichlorophenol | 0.050 |
| 2,3,6 Trichlorophenol | 0.050 |
| 2,3,5 Trichlorophenol | 0.050 |
| 2,3,4/2,4,5 Trichlorophenol | 0.050 |